Technical Report 69-102

A Study of U.S. Coast Guard Aviator Training Requirements

by

Eugene R. Hall, Paul W. Caro, Jr.,
Oran B. Jolley, and Cmdr. Gilbert E. Brown, Jr.

December 1969

Prepared for:

The United States
Coast Guard

Contract DOT-CG-9255A

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HumRRO Division No. 6 (Aviation)
Fort Rucker, Alabama
HUMAN RESOURCES RESEARCH ORGANIZATION

Technical Report 69-102
Project AVTRAIN

The Human Resources Research Organization (HumRRO) is a nonprofit corporation established in 1969 to conduct research in the field of training and education. It is a continuation of The George Washington University Human Resources Research Office. HumRRO's general purpose is to improve human performance, particularly in organizational settings, through behavioral and social science research, development, and consultation.

The findings in this report have not been approved by the Commandant of the Coast Guard and do not reflect official Coast Guard policy, unless so designated by other authorized documents.

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FOREWORD

This report by the Human Resources Research Organization presents the results of a study conducted for the United States Coast Guard. Its purpose was to identify aviator training requirements for use as a basis in deriving functional characteristics for synthetic flight training equipment. This report identifies the aviator training requirements. A second HumRRO Technical Report, 69-103, *Design and Procurement Bases for Coast Guard Aircraft Simulators*, provides a functional description of the equipment recommended for Coast Guard procurement.

The study was conducted by HumRRO Division No. 6 (Aviation), Fort Rucker, Alabama, where Dr. Wallace W. Prophet is the Director. The study was begun in mid-February, 1969, and completed in November, 1969. Dr. Paul W. Caro served as principal investigator. Commander Gilbert E. Brown, Jr., was the Project Officer for the U.S. Coast Guard. Mr. Russel E. Schulz of HumRRO provided valuable assistance in the data collection phase of the study. Acknowledgement is also made of the excellent cooperation and assistance provided by the many Coast Guard aviators who participated in the study.

Mr. Ralph E. Flexman, Director of the Institute of Aviation, University of Illinois, provided consulting assistance during the study. His assistance was particularly helpful in the preparation of the report chapter dealing with aviator training requirements.

The work was performed under Contract DOT-CG-9255A between HumRRO and the United States Coast Guard

Meredith P. Crawford
President
Human Resources Research Organization

SUMMARY AND CONCLUSIONS

STATEMENT OF THE PROBLEM

Current Coast Guard aviator training relies heavily on aircraft. Modern synthetic flight training equipment for use in the pilot training process has not been available within the Coast Guard. In recognition of the training benefits accruing to other users of such equipment, plus the promise of producing potentially better qualified aviators, through a combination of aircraft and simulator training than is possible in the aircraft alone, the Coast Guard appropriated funds and initiated exploratory efforts in 1968 to procure such equipment. These efforts were frustrated by inadequate knowledge of the desirable characteristics of synthetic equipment which would best meet the Coast Guard's unique training requirements.

Subsequently, the Coast Guard contracted with the Human Resources Research Organization (HumRRO) to conduct a study to define desired functional characteristics for such equipment and to develop funding and procurement plans for its acquisition.

APPROACH

To satisfy the purpose of the study, a project team was organized at HumRRO Division No. 6 (Aviation), Fort Rucker, Alabama. This team completed a systematic work program to define functional characteristics for synthetic devices. The program began with members of the team acquiring detailed familiarization with Coast Guard aircraft, operational missions, and operating procedures. This was obtained through study of relevant documentation and by visits to Coast Guard installations.

Since it was desired that the characteristics of synthetic devices reflect consideration for the training requirements that might be satisfied through their use, a detailed study was undertaken to define broad-based training objectives for Coast Guard aviation. To accomplish this, a comprehensive study of aviator requirements during operational missions was undertaken. The search and rescue (SAR) mission was chosen for this analysis, since it represents the most common and most demanding mission flown by Coast Guard aviators. In-depth interviews were conducted with aviators at selected Coast Guard Air Stations located along each of the three coastal regions of the United States and in the Great Lakes regions. Missions were chosen to represent operations in each of the four aircraft used by the Coast Guard primarily for SAR. The interview data were used as a principal basis for developing a narrative description of aviator performance in the accomplishment of SAR missions. It was also used to compile a tabular listing of the specific tasks involved.

To derive training requirements information, it was also necessary to consider the skill and knowledge characteristics of aviators new to the Coast Guard who would be trained to perform operational SAR tasks. The differences between what they already could perform competently and what they must do in the operational mission context would define the

further training required in the Coast Guard. Input level skills and knowledges were assessed by a visit to the Naval Air Training Command (NATC) where Coast Guard aviators received initial flying training. Interviews with training personnel were conducted and subsequent study was made of documentation describing NATC training and training practices.

Since the development of specific programs of instruction for Coast Guard aviator training fell outside the scope of the present effort, training requirements developed were to a level appropriate to reveal desirable functional characteristics for synthetic devices, and to provide a basis for subsequent development of specific operationally oriented training programs.

RESULTS

The results of this analytical study are presented in this report. The body of the report describes Coast Guard aviator activities during SAR. Relevant training which aviators receive in preparation for specific aircraft duties, and training requirements for Coast Guard aviation are discussed.

A second report, *Design and Procurement Bases for Coast Guard Aircraft Simulators*, Technical Report 69-103, was produced in part from the results of this present report. It describes the Variable Cockpit Training System (VCTS) which was identified as suitable for Coast Guard use in providing synthetic training for satisfying training requirements.

CONCLUSION

The task-referenced information presented herein provides a suitable basis for the specification of functional characteristics for synthetic flight training equipment to meet Coast Guard aviator training requirements.

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A STUDY OF U. S. COAST GUARD
AVIATOR TRAINING REQUIREMENTS

PROBLEM AND APPROACH

BACKGROUND

The United States Coast Guard is specifically required by Title 14 of the U. S. Code to render public service in a number of broad categories. Duties include enforcement of applicable maritime laws of the United States, operation and maintenance of aids to maritime navigation, providing assistance to other federal agencies in performing their duties, standing ready to serve as a specialized branch of the Navy during wartime and providing assistance at sea and promoting maritime safety. The Title further gives the Coast Guard specific statutory authority and responsibility for developing, establishing, maintaining, and operating rescue facilities and for rendering aid to distressed persons and property on and over the high seas and waters subject to the jurisdiction of the United States. It also provides that the Coast Guard may "perform any and all acts necessary to rescue and aid persons and protect and save property...at any time and at any place at which Coast Guard facilities and personnel are available and may be effectively utilized." Functioning within the broad statutory framework of Title 14, the Coast Guard maintains and operates a variety of facilities for performing diverse activities in accomplishment of their assigned missions. Aviation constitutes one of the major facilities.

Aircraft are flown in support of all Coast Guard responsibilities. For example, they are used as patrol vehicles to detect and suppress violations of maritime laws and to fly logistics missions to resupply long-range aid to navigation (LORAN) stations maintained by the Coast Guard. Helicopters, deployed with vessels, serve as lead vehicles to locate and direct icebreakers to ice formations for clearing shipping lanes. Routine missions are flown to transport and assist agents of other federal agencies to perform their duties (e.g., water temperature surveys, fisheries and wildlife patrols). Most importantly, they are flown to accomplish search and rescue (SAR) missions. Coast Guard aviators fly approximately 25,000 hours annually to perform operational SAR missions. All other duties involving aircraft are considered subordinate to this duty.

SAR encompasses all of the assistance activity on and over water areas embodied in the broad term of "marine safety." It includes search for, and rendering of assistance to, persons, aircraft, and water craft in distress on and over water. Both rotary wing and fixed wing aircraft are flown for SAR. Helicopters are used principally as rescue vehicles for evacuating individuals to places of safety or to medical facilities. Fixed-wing aircraft are used principally as search vehicles, often conducting long, extended over-water searches. They are also used for aerial delivery of equipment needed to alleviate distress conditions and to intercept distressed aircraft and escort them to safe landing sites. Assistance is rendered to personnel, aircraft, recreational water craft, fishing vessels, and merchant ships of all nations.

To perform all operational mission assignments proficiently, and especially SAR missions, aviators require training. Training is needed for the pilot to become initially competent to control safely specific Coast Guard aircraft. It is also needed for the qualified pilot to sharpen his flying skills and to learn procedures unique to SAR. The Coast Guard

aviator must learn effectively to utilize his aircraft and efficiently to manage his resources for SAR mission accomplishment.

Currently, 27 air stations are maintained worldwide by the Coast Guard. Most have a primary SAR mission. All of these air stations conduct flying training programs for assigned personnel in addition to satisfying their operational mission requirements. The Training Section (TRASEC) at the U. S. Coast Guard Aviation Support and Training Center (CGAVSUPTRACEN) is the only unit that has training as its primary mission. In 1967, Coast Guard aviators flew almost 38,000 (aircraft) hours for training. This accounted for more than 40 percent of the total number of hours flown for all reasons that year.

At the present time, Coast Guard flying training programs are characterized by reliance on the operational aircraft itself for the learning, enhancement, and maintenance of flying skills. The other uniformed services engaged in pilot training and, most notably the commercial airlines, have made effective use of synthetic flight training equipment for training aspects of the flying job in a safe, less costly environment. Recognition of the value of synthetic devices, especially aircraft simulators, for pilot training is currently being formalized through a proposed rule change to FAA regulations which would permit substitution of simulator hours for aircraft hours. The proposed change states, in part:

> "It appears that a combination of simulator/airplane training results in a pilot who is better trained than one trained in the airplane alone. Simulators permit more concentrated training without waste of time and effort and the trainees can be allowed to see and correct their mistakes without any detrimental effect on safety of flight. Therefore, it becomes more and more worthwhile to utilize ground training devices, particularly aircraft simulators for training purposes."[1]

Recognizing the potential value of simulation for aviator training, the U. S. Coast Guard initiated efforts in early 1968 to procure synthetic flight training equipment for use in Coast Guard aviator training programs. These early efforts were hampered by difficulties encountered in specifying acceptable characteristics of synthetic devices that would be of maximum value to Coast Guard aviation training. Subsequently, the Coast Guard contracted with the Aviation Division of the Human Resources Research Organization (HumRRO) in February 1969 to assist in formulating optimum device characteristics and plans for the acquisition and development of such devices.

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[1]Federal Aviation Administration, Department of Transportation. *Training Programs, Airplane Simulators, and Crewmember and Dispatcher Qualifications; Flight Maneuvers*, Notice of Proposed Rule Making, Federal Register 34, 6112, April 4, 1969.

OBJECTIVES OF THE STUDY

The principal objectives of the study to be conducted concerned (1) the specification of functional characteristics required in synthetic flight training equipment for meeting Coast Guard training objectives, and (2) the development of procurement plans for such devices. The attainment of these objectives is documented in a separate report.[1] To meet these principal objectives a number of intermediate objectives had first to be achieved. To specify "optimum" characteristics in synthetic training equipment for Coast Guard training purposes, it was first necessary to identify the training required and achievable through synthetic device use. Thus, the major intermediate objective was to define training requirements for Coast Guard aviation. This was to be done by analyzing Coast Guard aviator activities in SAR to derive performance requirements and to compare these requirements with the skills and knowledges already possessed by aviators entering Coast Guard training programs. The manner in which this was done and the results achieved are reported herein.

APPROACH

To meet the principal objectives of the study (i.e., to define functional characteristics of synthetic training devices for Coast Guard aviator training) and the major intermediate objective (definition of training requirements), a study team was organized at HumRRO Division No. 6 (Aviation). This Division operates at the U. S. Army Aviation Center, Fort Rucker, Alabama. All members of the team had had previous experience with aviation and pilot training. Three of them hold fixed and/or rotary wing aviator ratings. They were also familiar with the design and use of synthetic flight training devices and with the current state-of-the-art in simulation technology. This team was augmented during certain of the study activities by the use of consultants. Their participation is defined in appropriate sections below.

In achieving the overall goal the study team accomplished a number of work activities, all oriented toward the final objective. These activities involved an analysis of operational missions, an assessment of trainee input capabilities, and derivation of training requirements for Coast Guard aviation. They also involved specification of functional characteristics for synthetic devices that could satisfy specific training requirements and the development of funding and procurement plans for those devices. Each of these items is discussed in more detail below.

Analysis of Operational Missions

To specify adequately the desirable characteristics of synthetic flight training equipment which is intended for use in training aviators to perform specific flying tasks, it is necessary that a thorough

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[1]Caro, Paul W., Hall, Eugene R, and Brown, Commander Gilbert E., Jr. *Design and Procurement Bases for Coast Guard Aircraft Simulators*, HumRRO Technical Report 69-103, December 1969.

understanding of the constituents of the required operational performance be held. This is so the characteristics of the device will permit the construction of relevant learning experiences in which practice on critical elements of the operational tasks can be gained. The extent to which characteristics of a device duplicate (i.e., "simulate") aspects of the operational tasks is an important determinant of its value in terms of the transfer of the skills learned in the device to operational flying assignments.

For the analysis of operational performance, the SAR mission was chosen by agreement between HumRRO and the Coast Guard Technical Monitor. SAR is the primary responsibility of Coast Guard aviation and the performance of SAR missions exercises almost all of the total aircraft capabilities. SAR therefore includes virtually all of the flying tasks involved in other (non-SAR) missions flown by the Coast Guard.

The specific objective of this particular work effort then was to determine the activities performed by pilots flying SAR cases. The manner in which these tasks are accomplished and the conditions (e.g., environment, crew interactions, equipment factors) which influence the ease or difficulty of performing them were also of concern. The results of this effort would yield an organized listing of job-relevant activities. This listing would serve to define the tasks which aviators must learn and maintain proficiency to perform SAR effectively. The output of this effort, a description of aviator performance during SAR, is presented in the following section of this report and in the training requirements section.

Familiarization. Initial preparation for the study consisted of obtaining detailed familiarization with the operating procedures of the Coast Guard, with the procedures involved in SAR, and with the characteristics of Coast Guard SAR aircraft. For this purpose, the Coast Guard Air Operations Manual (1), the National Search and Rescue Manual (2), the flight manuals for the various CG aircraft (3, 4, 5, 6) and a variety of other documentation (e.g., the Coast Guard Communication Manual (7)), previous Coast Guard studies, and training syllabi were studied. Early in the study, a trip was made with the Coast Guard Technical Monitor to the Coast Guard Training Section (TRASEC) at Mobile, Alabama, and to the Coast Guard Air Station (CGAS) at New Orleans, Louisiana. This trip was made for orientation and first-hand observation of training practices and SAR operations in aircraft. Participation in actual flights aboard the HU16E, HH52A, and HH3F was also involved. More detailed familiarization with SAR procedures was subsequently obtained by the study team through attendance at a specially devised training program at the National SAR School.

Data Collection at Coast Guard Air Stations. To obtain the information required for the study, visits were scheduled to six operational Coast Guard Air Stations. Air Stations were selected along each of the coastal regions and in the Great Lakes area. The Air Stations, chosen in conjunction with the Coast Guard Technical Monitor, were selected to provide a representative geographical sample of SAR air operations and to sample SAR missions flown in all four operational SAR aircraft. The schedule of these visits is shown in Appendix A. Data concerning SAR practices was obtained by conducting in-depth interviews of aviators who routinely fly these missions. Approximately 40 such interviews were held. Members of the study team also

flew aboard Coast Guard aircraft. The in-flight observation was considered necessary, both to assure the completeness of the data collected and to allow the study team to develop a greater appreciation for the SAR task.

Detailed "questionnaires" were prepared for use at the Air Stations in interviewing Coast Guard operations and training personnel. The items were developed from knowledge gained during the initial familiarization. They were reviewed with the Coast Guard Liaison Officer assigned to the Army Aviation Center, Fort Rucker, Alabama, prior to use at Coast Guard Air Stations. One questionnaire was designed for completion by the Operations Officer. This was used to obtain general descriptive information as well as some specific information concerning operations at a particular station. It was felt that this type of information would be necessary to determine how an aviator's flying tasks might be affected as a function of the station to which he was assigned (e.g., lack of instrument facilities at a station).

A second "questionnaire" was in reality an interview guide. It was used by the research team to interview pilots on an individual basis. This questionnaire was divided into two parts. One dealt with a recent specific SAR mission in which the aviator had participated. The second part was concerned with the more general aspects of his SAR experiences. In both cases, the items were arranged to represent a logical progression of events within a (typical) SAR mission. It was intended that the items in each part serve to structure the interview and to stimulate discussion of specific aspects of SAR operations.

The data obtained from the station visits provided the primary basis for this report. The knowledge gained through this means (and supplemented by ... dy of aircraft handbooks, station and Coast Guard operating procedu... s documents, SAR publications, ... nd other relevant documentation) is, of course, used throughout the report.

Study of Trainee Input Factors

This effort involved an assessment of the skills and knowledges brought into CG aviation training programs by pilots new to the Coast Guard. The output of this effort defines and describes the characteristics of entering pilots. It also allows for a comparison between these characteristics and performance that will subsequently be required operationally Such comparisons yield sets of training requirements in terms of defined differences between what an individual knows and is able to do at a given point in time versus what he must know and be able to do at some subsequent point in time.

Currently, the U. S. Naval Air Training Command (NATC) provides primary training and basic and advanced training in rotary wing and multi-engine propeller aircraft for Coast Guard aviators. Their initial designation as aviators is awarded by NATC. Training programs and materials used by NATC were reviewed and a visit was made to that Command to interview Coast Guard and Naval personnel engaged in training aviators. Information sought concerned the level of competence of aviators newly graduated from the Naval aviator training program. Areas examined were length and types of courses, aircraft types, instructional practices and other aspects of the training program which interact to produce a pilot product with definable capabilities. The information obtained is

described in the section of this report concerning training. It was also used in preparing the section which discusses training requirements.

To complete the description of training to be accomplished, the aviator training programs currently conducted by the Coast Guard were also examined. For this, training syllabi and other training materials were obtained from Coast Guard Air Stations worldwide. These were reviewed for their implications for establishing objectives for possible future Coast Guard training programs and for specifying desirable characteristics of synthetic flight training equipment. They were also used, along with other previously described sources of information, to derive training requirements for experienced Coast Guard aviators transferring their skills to new types or categories of aircraft. Coast Guard training is also described in the third section of this report.

Determination of Training Requirements

This effort concerned specification of the training required for aviators to achieve satisfactory knowledges and skills for various levels of performance. Skills and knowledges were derived from the descriptions of operational SAR performance. These were compared with entry level capabilities of new aviators and of experienced aviators becoming qualified in different aircraft. This material is presented in the section defining training requirements.

As part of this effort, consideration was given to various alternate modes of training (i.e, synthetic, flight, or academic training) whereby given requirements could be achieved. This resulted in a categorization of the requirements by mode of training best suited for their fulfillment. Where multiple modes applied, consideration was given to cost and effectiveness of these modes. The requirements were also considered in terms of particular training programs, i.e., transition, qualification and proficiency training programs, in which they should be included.

The basis for the categorizations was largely judgmental stemming from the previous experience of the research team with aviator training and their background knowledge of training technology. Material assistance in making these judgments was also provided by a consultant, a recognized aviation training expert,[1] who assisted in the assignment of requirements to categories.

The present report, *A Study of U. S. Coast Guard Aviator Training Requirements,* was prepared from the outputs of the work efforts described above. This report is intended to serve principally as documentation of the bases upon which the functional design of synthetic flight training equipment for Coast Guard usage was predicated. It will also be useful for developing detailed programs of instruction for specific training purposes.

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[1]Mr. Ralph E. Flexman, Director of the Institute of Aviation, University of Illinois.

A companion report,[1] published separately, delineates the design features considered desirable for Coast Guard synthetic flight training equipment. The work efforts accomplished in producing this second report are described briefly below.

Specification of Device Functional Characteristics

Within the framework of the overall study, a subsidiary objective was to develop the least expensive and least complex combination of synthetic training equipment that could be used effectively to meet synthetic training requirements. Various alternate arrangements and types of equipment were considered. Cost estimates were developed. The results of equipment cost trade-offs are presented in the companion report.

A Qualitative Materiel Requirement (QMR) which states the functional characteristics of equipment to meet Coast Guard aviator training requirements is presented as an appendix to the simulator design basis report. Past experience has shown that the QMR format will be suitable for subsequent use in the development of detailed specification(s) for Coast Guard use in procuring synthetic flight training equipment.

Development of Funding and Procurement Plans

The final work effort of the overall study involved the preparation of a procurement and funding schedule for Coast Guard guidance in any subsequent procurement action. This included time phasing and funding recommendations. This information has been provided in appropriate places throughout the simulator design basis report.

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[1] Caro, Paul W., Hall, Eugene R., and Brown, Commander Gilbert E., Jr. *Design and Procurement Bases for Coast Guard Aircraft Simulators,* HumRRO Technical Report 69-103, December 1969.

THE SEARCH AND RESCUE MISSION

This section describes the characteristics of Coast Guard SAR aircraft and the activities of Coast Guard aviators engaged in the conduct of SAR operations.

SAR AIRCRAFT

Currently, the Coast Guard operates four aircraft with primary utilization for SAR; the HC130B[1], the HU16E, the HH52A, and the HH3F.

HC130B -- The HC130B Lockheed "Hercules" is a pressurized, all-weather, high performance, four-engine, turbo-prop, long-range aircraft. This aircraft is used extensively to intercept distressed aircraft and escort them to safe landing sites. It is also used for search, especially when the search area is a considerable distance off-shore, and for aerial delivery of survival equipment. The HC130B is capable of flying 1200 nautical miles to a search area at a speed of 300 knots and an altitude of 25,000 to 30,000 feet. It may descend to an appropriate search altitude, shut down two of its four engines to conserve fuel, and sweep a search area at 150 - 200 knots for 2.5 hours before restarting the idle engines and returning to base with reserve fuel. It has the ability to effectively sweep thousands of square miles of the open ocean and to transport large quantities of rescue-survival equipment either for aerial delivery or for transportation to the scene of disasters.

Because it has superior communications capabilities, it is often used as an airborne command post to control and coordinate the search efforts of other aircraft and surface vessels. It may also function as a high altitude radio relay/navigation platform for surface craft or for aircraft at lower altitudes or of lower capability. On-board electronic equipment provides capability for: high frequency (HF), very high frequency (VHF), and ultrahigh frequency (UHF) communications; automatic direction finding (ADF); visual omnidirectional range (VOR) navigation; utilization of the tactical air navigation (TACAN) system, the long-range aid-to-navigation (LORAN) system, and the instrument landing system (ILS). The aircraft is also equipped with a doppler navigation system and with a transponder for identification, friend or foe (IFF) purposes with a selective identification feature (SIF). Celestial navigation equipment is also carried and the aircraft has a weather/navigation/search radar.

A normal aviator crew for the HC130B on a SAR mission consists of a pilot, a copilot, and a navigator The navigator position is filled by a third aviator who typically rotates positions with the other aviators

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[1]The Coast Guard has three HC130Hs which are also used routinely for SAR. One HC130E, while not routinely used for SAR, is considered available for this purpose. Since the HC130B is the predominant model in the Coast Guard, this designation will be used in the report when referring to HC130 operations.

on long duration missions. Enlisted crew members include a radio operator, a flight engineer, two observers, and a loadmaster. The HC130B aircraft has an on-scene commander's position in the cockpit.

HU16E -- The HU16E Grumman "Albatross" is an all-weather, amphibious, twin-reciprocating engine, medium range fixed-wing aircraft. It is used principally for aircraft intercept, search, and aerial delivery. Its radius of action and overall performance capabilities are less than the HC130B's. Consequently, the utilization of this aircraft is most extensive in a medium range zone (100 - 300 miles off the coastline). As a search aircraft, it can proceed 500 nautical miles off-shore, search for 2.5 hours, and return to home base with reserve fuel. Although the aircraft has amphibious capabilities, it is seldom used for making open-sea landings because of the dangers involved in this operation. Hence, it lacks generally effective rescue (recovery) capability.

Communications and electronic equipment include low frequency (LF), HF, VHF, UHF radios, VOR, TACAN, ADF, ILS, IFF, LORAN, UHF/VHF DF, and a search radar.

A normal SAR crew for the HU16E consists of a pilot, a copilot, an enlisted radioman, and three other enlisted air crewmen. A third aviator may also be used for the HU16E if the search is anticipated to extend over several hours duration. The third aviator provides control relief to the pilot and copilot and performs navigator functions.

HH52A -- The HH52A Sikorsky "Seaguard" is an amphibious, single-turbine, single rotor, short range helicopter. The principal use of this aircraft is recovery of individuals in distress. It may also be used as a search vehicle, but generally search operations are confined to areas where visual reference to landmarks or shore is readily available. There is an increasing trend toward use of the aircraft in conjunction with a Coast Guard cutter for conducting searches. The cutter performs basic navigation and serves as an electronic/visual reference point for the helicopter. In certain cases it may also be used as a refueling platform.

The aircraft has limited navigational capability. Communications and electronic equipment include HF, VHF, and UHF radios, ADF, VOR, ILS, and IFF. At the present time, approximately 25 percent of the Coast Guard's HH52As have TACAN. TACAN will be installed in all of these aircraft within the next two years. A VHF FM communications radio is also being installed in all aircraft with completion of this installation scheduled for early 1970. A weather/navigation/search radar for installation in the aircraft is undergoing test and evaluation.

Because of its limited navigation capability and its single engine configuration, independent SAR operations with the HH52A aircraft are usually confined to areas relatively close to shore. Most Coast Guard Air Stations limit its operation without an escort to 10 - 15 miles off-shore. With an escort (e.g., an HU16E) to perform navigation, the HH52A can proceed 150 nautical miles off-shore at 90 knots, hover for twenty minutes or land on the water, pick up four survivors, and return to base with reserve fuel.

A normal crew for the HH52A is a pilot, copilot, and one SAR aircrewman to operate the hoist. The aircraft can, however, be operated by a single pilot. A copilot is required for night-time operations and for flight under instrument conditions (1).

HH3F -- The HH3F, the Coast Guard's newest aircraft, is an amphibious, twin-turbine, single rotor, medium range helicopter. It is used for both search and rescue. The aircraft can proceed 300 nautical miles at 125 knots, hover for 20 minutes or land on the water, pick up eight survivors, and return to base with reserve fuel. Alternately, the HH3F can proceed 220 miles from base, search for two and one-half hours, and return to base with reserve fuel. The aircraft is equipped with the latest navigation and communication equipment, and can carry passengers, cargo, stretchers, and small vehicles or boats.

Communications and associated electronic equipment include HF, UHF, VHF radios, LF ADF, UHF/VHF ADF, IFF, VOR, ILS, TACAN, doppler, weather/search/navigation radar, LORAN A, and a navigation computer. Development of concepts to enable aerial refueling of the aircraft to extend its range/endurance is now being accomplished by the Coast Guard. A normal crew for the aircraft consists of two aviators--a pilot and a copilot--and two enlisted men--a radio operator and a hoist operator.

AVIATOR PERFORMANCE DURING SAR MISSIONS

The description which follows of aviator performance during SAR missions is organized in terms of eight overlapping phases which comprise a mission. The mission begins with (1) the aviators' preparation on the ground, proceeds with (2) the departure of the aircraft from the operating air station, and (3) the establishment of the appropriate configuration and course(s) that will place the aircraft in the designated mission area. (4) Search and/or (5) rescue activities are then accomplished. Upon their completion, (6) the aviator establishes a return configuration and accomplishes the necessary navigation, (7) approaches the airfield, lands, and (8) completes the required post-flight tasks. This sequence is shown in Figure 1. Table 1 provides a listing of major elements within each phase.

In this section of the report, significant aviator activities involved in each mission phase are first summarized and the activities performed by aviators in accomplishing the major element in the phase are delineated. In preparing the SAR mission description, an attempt was made to extract the common performance elements across the four types of aircraft. Where necessary, however, performance deviations as a function of the particular aircraft involved are identified.

1.0. Ground Preparation. This phase begins when a pilot is notified that he will be involved in an ongoing or impending SAR case. Major activities include his own and the copilot's preparation for the mission. This includes the assembly and utilization of information necessary for the mission (mission planning), obtaining and stowing of necessary SAR gear, crew briefing, and aircraft preparation. The phase ends with the necessary preflight activities accomplished, engine(s) running, pre-take-off procedures completed, clearances obtained, and the aircraft ready for take-off.

1.1. Receive Notice of Required SAR Flight. All Coast Guard Stations having a primary SAR mission maintain a 24-hour operations watch for messages requiring deployment of assigned aircraft. When these aircraft are required immediately to assist in urgent distress situations, they are launched as quickly as possible (scramble). When the requirement

SAR MISSION PHASES

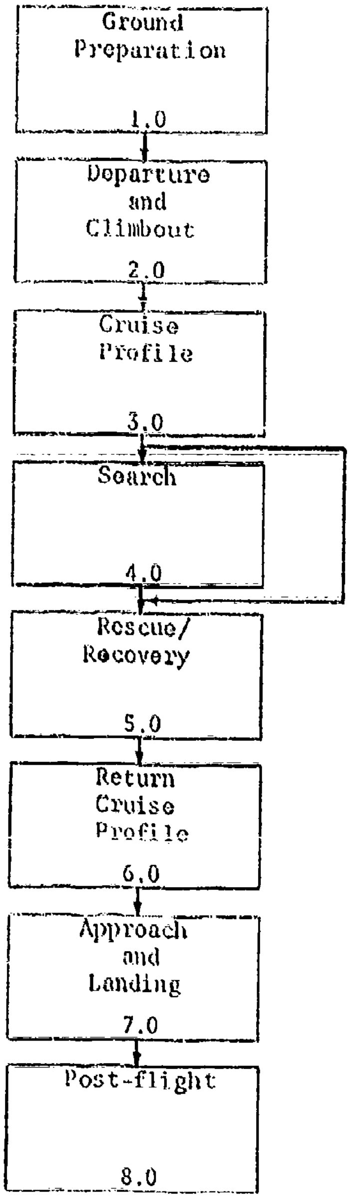

Figure 1

Table 1

SUMMARY OF SAR MISSION ELEMENTS

1.0. Ground Preparation

1.1. Receive notice of required SAR flight
1.2. Plan SAR mission
1.3. Obtain necessary SAR gear
1.4. Brief crew on mission
1.5. Accomplish aircraft preflight inspection
1.6. Accomplish starting procedures
1.7. Taxi aircraft to take-off position

2.0. Departure and Climbout

2.1. Accomplish final pre-take-off procedures
2.2. Receive take-off clearance
2.3. Accomplish take-off
2.4. Accomplish post-take-off procedures
2.5. Establish (maintain) appropriate climb configuration
2.6. Maneuver aircraft to conform to departure procedures
2.7. Accomplish required reporting

3.0. Cruise Profile

3.1. Establish/maintain cruise configuration
3.2. Establish communications with destination
3.3 Perform enroute navigation
3.4. Monitor aircraft/system status
3.5. Accomplish required reporting
3.6 Determine initial mission area has been reached

4.0 Search

4.1. Descend to mission altitude
4.2 Establish initial search configuration
4.3 Conduct search activities
4.4 Accomplish required reporting
4.5. Obtain contact with possible objective
4.6 Initiate approach to objective
4.7. Identify target
4.8 Resume search
4.9 Revise/modify search procedures
4.10. Suspend search

Table 1 (Continued)

5.0. Rescue/Recovery

5.1. Fixed Wing Rescue/Recovery Activities
5.1.1. Accomplish aerial d livery
5.1.2. Accomplish aircraft intercept/escort
5.1.3. Provide rescue assistance
5.1.4. Accomplish water landing
5.2. Rotary Wing Rescue/Recovery Activities
5.2.1. Establish hover
5.2.2. Accomplish hoist operations
5.2.3. Accomplish drop operations
5.2.4. Accomplish water landing
5.2.5. Accomplish confined area/shipboard landing
5.2.6. Accomplish boat towing

6.0. Return Cruise Profile

6.1. Accomplish take-off as required
6.2. Establish climb configuration
6.3. Establish return cruise profile
6.4. Perform enroute navigation
6.5. Monitor aircraft/system status
6.6. Accomplish required reporting
6.7. Determine destination airfield descent area has been reached

7.0. Approach and Landing

7.1. Begin descent
7.2. Accomplish prescribed VFR or IFR approach
7.3. Execute landing

8.0. Postflight

8.1. Taxi aircraft to parking area
8.2. Complete postflight checks and secure aircraft
8.3. Accomplish required reporting

for aircraft is not immediate, e.g., an alert condition exists, their launch will be deferred to some subsequent time (preplanned launch). On scramble launches, the location of the distress object or area for search will normally be known, or readily ascertainable through utilization of electronic equipment aboard the aircraft. Scramble launches typically have minimum requirements for extended search. On preplanned launches, the location of the search object will generally not be known and not be readily ascertainable, but search areas will have been assigned. Hence, extended search operations will likely be required. In some instances, initiation of a SAR mission occurs while the aircraft is already airborne conducting some other type of mission, e.g., training. In such cases, the order to divert is relayed by his home station Operations.

Watch-Standing Duty Officers and aircraft (generally one aircraft of each category assigned) are available for scramble launch within 30 minutes (Bravo-Zero status) of receipt of notification that a distress situation has occurred. Notification is usually by telephone from the District Rescue Control Center (RCC) to the station's Operations Center, although notification may be received from any source. In urgent distress cases, the Operations Officer may launch aircraft on his own authority, with notification of such action to RCC. Upon receipt of notification requiring a scramble launch, the Operations Center sounds an alarm and passes a general message over the public address system. A typical message might be, "Put the ready helicopter on the line, man in water near X Island." This type of message is often the only briefing received by a crew prior to a scramble launch. The intent of a scramble launch is to get the aircraft into the air, headed in the general direction of the distress, as quickly as possible. Amplifying information concerning more precisely the nature and location of the distress is relayed to the aircraft via radio as soon as it is available.

If the nature of the mission permits, e.g., to search an area of open sea for an overdue vessel, notification will normally be received and relayed to a designated crew in time for detailed mission planning to take place. Often in such cases, the location of the object will not be known with any precision. Typically, however, the aviators, prior to launch, will know the circumstances and urgency of the mission, including what the object is, where it is or might be located, and the nature of its distress (e.g., overdue, taking on water). Frequently, the aviators will also know the type of equipment that the vessel is carrying for communications, survival and signalling, and the number of people involved.

1.2. Plan SAR Mission. Once notification has been received by the aviators that a launch is scheduled, planning must be accomplished to determine flight routing to the search area. Planning must also determine what to do on arrival at the scene, i.e., how to conduct the search operation or effect the necessary recovery. The precise form, content, and extent of planning to be accomplished for each mission varies. However, it may include specific search or rescue planning in addition to the more general flight planning.

When search is required, the RCC, or sometimes a SAR Mission Coordinator (SMC),[1] will usually specify the area to be searched. Selection of the search area will be in accordance with procedures detailed in the National SAR Manual (2). These procedures result in a determination as to the most likely area that a search object will be in at a given time. This determination is based on the object's last known or estimated position, the effects of winds, sea currents, and object characteristics which would affect its rate and direction of movement over time and determine its probable position. Specification of the area to the aviator (or station) may be stated in a variety of ways. Often it is in terms of (1) an area between sets of coordinates, (2) an area around a set of coordinates (e.g., an area around a vessel, oil rig, etc.), (3) a distance away from and along the shoreline, (4) areas around or between geographical locations or positions (e.g., between Islands X and Y), or (5) a square or rectangular area with sides of a given length with the center defined by coordinates. Often the direction of travel along/across the search area is also specified. Since some Air Stations often perform SMC functions, assigned aviators may be required to collect initial information on the object and themselves determine probable position estimate before initial search activities commence.

Regardless of how the mission area was selected and the specific activity to be accomplished there, the first task in SAR planning for the individual aviator designated to fly a specific mission is to determine where the area is so that he can plan the flight to it. This involves reference to appropriate maps and charts, selection of navigation facilities enroute, planning for use of onboard navigation capabilities (e.g., doppler in HC130B, navigation computer in HH3F), preparation and filing of a flight plan to include course, airspeed, enroute time(s), altitude, whether penetration of an Air Defense Zone, or restricted or warning areas is involved, etc.

Local, enroute, and mission area weather must be considered by the aviator in his planning. In some instances (e.g., maximum range missions), he may be required to compute weight and balance conditions for his aircraft, although this is not usual since all Air Stations have a standard SAR configuration for each type of assigned aircraft.[2] Frequently, he must determine the fuel required to accomplish the mission and order the appropriate quantity. Sometimes, especially in the case of helicopters, this may require defueling of a ready aircraft. Time permitting, the overall mission planning is accomplished on the ground, usually by the designated pilot and copilot jointly. Frequently, the Watch Standing Duty Section will accomplish this planning and transmit the information to the pilot if he is not a member of that Section. On scrambles, much of this planning must be done in the air.

Planning for activities in the mission area involves consideration for how to conduct a specific search operation or rescue activity. Normally, the rescue control agency (RCC or SMC) will specify the particular type of search pattern to be flown and the track spacing through the area. In such cases, the aviator's principal planning is concerned with the ability of his aircraft to complete the search area assigned while

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[1]An SMC is an official assigned responsibility for the conduct of a particular SAR mission (2).

[2]The configurations are not standard between stations, however.

maintaining the desired probability that the object will be located. This planning provides for proper utilization of his crew as well as the aircraft. When a detailed search procedure is not specified, the aviator may be required to select a procedure, following instructions set forth in the National SAR Manual (2). This will involve consideration for the characteristics of the object being sought, prevailing visibility and weather conditions, and determination of the distances required along and between search tracks to insure a desired probability of detection (POD) of the search object.

Frequently, a CG fixed-wing aircraft commander will be designated as On-Scene Commander (OSC) in a search area with responsibility for both participating in the search and coordinating the efforts of other units (vessels, aircraft). Consequently, his mission planning must include consideration for how to employ other search units so as to cover the assigned search area effectively.

Fixed-wing aircraft often are employed to intercept aircraft in distress and to escort them to safe landing sites.[1] In such cases, the aviator is required to assemble information relative to the speed, altitude, heading, and condition of the distressed aircraft; to devise the appropriate intercept course; and to compute time and position of intercept. Preparation and planning for this type of mission also involves consideration for the possibilities of being required to evaluate sea conditions, advise the distressed aircraft on appropriate ditch headings,[2] ditching procedures, overflying the ditch area and/or illuminating sea lanes. These requirements are amplified in *Aircraft Emergency Procedures Over Water* (3).

1.3. Obtain Necessary SAR Gear. A standard list of SAR gear is carried for each particular type of aircraft assigned to a given Air Station. The pilot is responsible for assuring that all such SAR gear is properly stowed aboard the aircraft. When the nature of the mission suggests that other gear may be required, e.g., extra flares for night search operations, or a litter for medical evacuation of severely distressed individuals, he instructs the crew to stow it aboard.

1.4. Brief Crew on Mission. If time is available (see 1.1 above), the pilot will brief the crew on the general nature of the SAR mission to be accomplished prior to aircraft launch. For scramble type launches or diverted flights, the crew will receive a general briefing over the communications radios simultaneously as the pilot. (Crewmen normally listen in on ground-to-air communications.) Specific briefings, defining the roles of participants, are not normally given at this time. These are given by the pilot over the aircraft intercommunications system (ICS) prior to arrival in an initial search area (see 4.0) and/or prior to initiation of a specific rescue/recovery operation (see 5.0).

1.5. Accomplish Aircraft Preflight Inspection. At most Air Stations, a "ready aircraft" concept is used so that the aircraft can be launched with a minimum delay when its use is required. This means that a complete preflight, as prescribed in the Operators' Manual for the aircraft involved, will have been accomplished at some previous time. In

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[1]This requirement is decreasing, particularly on the East Coast, because modern commercial and many military aircraft have higher performance capabilities than the Coast Guard aircraft.

[2]Ditch headings are published at least once daily by Fleet Weather Centers for given geographical areas and are available to SAR pilots.

some cases, ground maintenance technicians accomplish the inspection under pilot supervision. In others, the copilot and/or pilot will accomplish the inspection, leisurely, particularly if they are the watch standing aviators. For scramble launches, the aviator will accomplish a quick inspection to verify critical items while preparing to launch. Aviators also will accomplish a complete preflight for a preplanned mission which does not involve the ready aircraft.

1.6. Accomplish Starting Procedures. A wipe-out procedure (i.e., simultaneous checking of a number of switch positions) is used in the HH52A helicopter to determine the correctness of control settings prior to engine starting. A challenge and reply system, employing a formal checklist and requiring item checking on an individual basis, is used for the HH3F, HU16E, and HC130B aircraft. The tasks required for the complete start, runup, and post-start sequences for each of the aircraft are detailed in the appropriate Operators' Manuals and/or Standardization Manuals (see 4, 5, 6, 7, 8).

1.7. Taxi Aircraft to Take-Off Position. After completing the post-start procedures and power checks, the pilot taxis the aircraft into position ready for take-off in accordance with instructions received from the airfield controller. The copilot completes the taxi checklist, copies any data being relayed concerning the case, monitors the engine instruments for safety indications, backs up the pilot on the aircraft controls, and communicates with the tower for take-off instructions and clearances. In the HH3F, the copilot may also begin programming the computer at this time.

2.0. Departure and Climbout. This phase begins with the aircraft lined up on the runway (or pad) ready for take-off. Activities of the pilot and copilot include completing the final pre-take-off aircraft checks and verifying that the aircraft is ready for flight. After receiving his take-off clearance, the FW pilot initiates his take-off roll and transitions to forward flight. The RW pilot performs his take-off as appropriate for load configuration and prevailing conditions. This phase also includes completion of the after-take-off climb checks by the copilot (and crew in FW aircraft) and maneuvering of the aircraft by the pilot to conform to prescribed or selected departure procedures. Transition from departure control to enroute control agencies may be effected. The phase ends with the aircraft prepared to level off at cruise attitude.

2.1. Accomplish Final Pre-Take-Off Procedures. The copilot completes the final instrument checks and other checks required prior to take-off in accordance with the checklists contained in the respective flight manuals (4, 5, 6, 7, 8).

2.2. Receive Take-Off Clearance. When the CGAS is a tenant at an airfield (military or civil), the pilot may be required to await clearance from the control tower before beginning his take-off. When proceeding on a SAR case, however, the aviator adds the word "Rescue" to his call sign and normally receives his take-off clearance from the controlling agency as soon as airspace can be cleared.

2.3. Accomplish Take-Off. During this segment, the FW pilot begins his take-off roll and at the appropriate time transitions to flight. The copilot backs up the throttles and monitors the warning lights and engine instruments. The helicopters usually accomplish normal take-offs to a hover prior to entering into a climb configuration. In high density altitudes, a running take-off will be accomplished in the helicopters. If necessary, any of the aircraft may accomplish an instrument take-off.

2.4. Accomplish Post-Take-Off Procedures. Post-take-off procedures are accomplished in accordance with checklists published in the appropriate Operators' Manuals. For example, in the HU16E, the crewmen observe engines and aircraft structure for leaks, fires, smoke, fumes, or other indications of potential or actual threats to safety of flight. In the HC130B, the flight engineer monitors the engine instruments and performs other required tasks (e.g., pressurizes the aircraft, manages fuel) as directed by the pilot.

2.5. Establish (Maintain) Appropriate Climb Configuration. Tasks accomplished by the pilot include the adjustment of power and control surfaces to establish the desired or proper rate of climb for prevailing load and environmental conditions. Portions of these tasks are performed by the copilot as directed by the pilot. The copilot also functions as a lookout and communicates with control agencies.

2.6. Maneuver Aircraft to Conform to Departure Procedures. All aircraft will conform to departure procedures specified by the control tower and/or to published station procedures. The pilot's principal concern is to depart the airfield as quickly as possible. On SAR missions the usual case is for the pilot to establish an initial heading to the designated area and climb out on that heading to depart the Air Station. In mountainous areas (e.g., West Coast), a climb to altitude may first be required. Under marginal visibility conditions, the pilot normally will receive radar vectors out of the area from local controlling agencies. Helicopters may stay below the cloud cover and follow visual landmarks for departure.

2.7. Accomplish Required Reporting. During departure, the copilot in the HH52A reports significant information to the ground. Normally, this is on HF to Coast Guard Operations at the home station and VHF or UHF to the control tower. In the HH3F, HC130B, and HU16E, required reports are normally transmitted to Operations by the radioman who has transmit/receive capabilities at his position. Tuning of radios to enroute facilities or guard channels will be accomplished by the copilot or radioman as required. Operations Normal and Position Reports will be dispatched in accordance with the requirements of the Coast Guard *Communication Manual* (9) and Local Station Operating Instructions, and local procedures.

3.0. Cruise Profile. This phase includes the activities of the pilot and copilot required to move the aircraft to its initial search position. The phase begins with the attainment of cruise altitude and establishment of the desired cruise configuration. Attempts to establish communications with the subject or on-scene craft are made during this phase. It includes the tuning and utilization of navigational equipment enroute, preparation and submission of position and situation reports, and monitoring of aircraft fuel consumption and other systems status indicators. The phase ends with the aircraft near the mission area and the pilot ready to take up the planned search activities or to effect rescue/recovery.

3.1. Establish/Maintain Cruise Configuration. Transition from climb to cruise begins when the pilot levels off at the assigned altitude. The pilot manipulates the aircraft controls to establish the desired airspeed, altitude, and initial course to destination, and trims the aircraft accordingly. In fixed-wing aircraft, the auto-pilot is usually engaged to facilitate the control task. In rotary-wing aircraft, control is actively maintained by the pilot or copilot. The automatic

stabilization equipment (ASE) in the HH52A lightens this control task. The automatic flight control system (AFCS) in the newer HH3F functions much like conventional auto-pilots in fixed-wing aircraft. Course to destination normally will be accomplished under positive air traffic control for fixed-wing aircraft, although the HU16E may operate below controlled airspace over open areas. The two rotary-wing aircraft normally operate below controlled airspace. In either case, however, appropriate published air traffic control procedures, i.e., ATC or ICAO, are followed. Occasionally, while enroute to the mission area, an active lookout for objects of prior unsuccessful searches is maintained.

3.2. Establish Communications with Destination. Initial attempts to establish communications with the object of the distress or other search units on scene, as appropriate, are attempted during this phase. Distances involved and the nature of the distress qualify equipment utilization. These communications attempts may be made by the radioman, copilot, or pilot-navigator depending upon the aircraft involved. Communications efforts may be aimed towards a distressed vessel, a homing beacon, a distressed aircraft, or to some other rescue aircraft or a vessel already on scene. Direction finding capabilities of each aircraft may also be used to obtain bearings to the area.

3.3. Perform Enroute Navigation. A variety of techniques and devices are used to accomplish enroute navigation. The choice depends upon their availability in the aircraft, aviator expertise in their employment, the distances to be traveled, and the altitude and assumed location of the search object. Near the shore, pilots rely principally on readily available landmarks for navigation, visibility permitting. Fixed wing aircraft and the HH3F may employ radar against land features for navigational mapping under limited visibility conditions. All aircraft may employ conventional instruments over water or in poor visibility. VOR, ADF, and TACAN are used extensively either singly or in combinations. Dead reckoning (DR) is prominently involved in general navigation for all aircraft.

All aircraft may also use their own direction finding (DF) capabilities directed against other air or surface craft (or the object of distress) for navigational purposes by obtaining relative bearings. They may also receive DF steers from other search units. Onboard radar may be used to obtain relative bearings and distances to targets. The IFF interrogator can be used for azimuth and range and TACAN for distance in the HU16E and HC130B when on intercept missions. Ship or shore based radar may provide vectors to given locations or around restricted areas. Doppler navigation may be used in the HC130B and HH3F. LORAN may be used by the HH3F, HU16E and HC130B. Use of LORAN is conditioned, however, by the availability of reliable signals. LORAN signal quality is generally acceptable on the Gulf and East Coasts so that it may be used as a primary navigation system for over water operation. The West Coast, however, is in a poor LORAN service area. There, departure from station over water is generally via VORTAC until signals are lost, then DR is used in the HU16E or doppler in the HC130B and HH3F to areas where LORAN is available. The navigational techniques and equipment appropriate to the four aircraft are summarized in Table 2 below.

The table indicates that navigational capability of the HH52A is currently limited. Because of this and its single-engine configuration, it is restricted by the Coast Guard from operating alone at any appreciable distance beyond visual sight of shore. With another aircraft with greater

Table 2

NAVIGATION CAPABILITIES OF SAR AIRCRAFT

Method	HH52A	HH3F	HU16E	HC130B
Pilotage	X	X	X	X
DR	X	X	X	X
VOR	X[a]	X	X	X
TACAN	X[b]	X	X	X
Radar	-X[c]	X	X	X
LORAN	-	X	X	X
Doppler	-	X[d]	-	X
ADF	X	X	X	X
UHF/VHF ADF	-	X	X	X
Nav. Computer	-	X[e]	-	-X[g]
Celestial	-	-	X[f]	X[f]
Flight Director System	-	X	-	X

[a]*Radio control heads are shared with the VHF communications radio. No VHF communications when VOR is being used. An emergency transmit function (on 121.5 MHZ) is, however, inherent in the system.*

[b]*Approximately 25 percent of the CG's HH52As are now equipped with TACAN. All will be within the next two years.*

[c]*Weather and search radar is now under test and evaluation for incorporation into the HH52A.*

[d]*Doppler navigation capability can only be used through the computer display panel.*

[e]*Accepts VORTAC, Doppler, or LORAN inputs. Can also be used as a manual DR system.*

[f]*Not routinely used by pilot.*

[g]*Accepts VORTAC and doppler inputs. May also be used as a DR system.*

navigational capability as escort, it may proceed to greater distances (100 - 150 miles) off-shore for rescue work. Operational range and capability is greatly enhanced when used in a ship/helicopter SAR team.

LORAN is the principal system used for off-shore navigation by the HU16E. The equipment is operated by a radioman usually, but may be operated by an aviator. Plotting is done by an aviator. Doppler navigation is used routinely for off-shore navigation by the HC130B with periodic updates (15 - 30 minutes) made by the navigator (or aviator), using LORAN information where it is available. The HH3F may use LORAN, Doppler, or VORTAC as inputs to its navigational computer which provides the principal navigational capability for this aircraft. LORAN is available (operated by a radioman) if the computer fails; doppler navigation is not available independently of the computer display panel. Programming of the HH3F computer for destinations and alternates (four total) is done by the copilot who also monitors the computer display panel for navigation information. In addition, the HH3F cockpit contains a map display for position keeping. An illuminated "bug" indicates present position. A permanent pen and ink record of the aircraft's ground track may be made.

3.4 Monitor Aircraft/System Status. While enroute to their destination, both the pilot and the copilot monitor the engine and flight instruments to determine if the aircraft is operating normally within the desired flight envelope. In the HC130B, the flight engineer also monitors the system status indicators and engine instruments. In both fixed-wing aircraft the crewmembers make periodic aircraft security checks and log pertinent data as necessary.

3.5. Accomplish Required Reporting. While enroute, the HH52A copilot makes periodic reports on HF to the home station advising them of status and position. In the three other aircraft, an enlisted radioman maintains communications with the station and issues periodically an Operations Normal report. Other reports are made under pilot direction. During this phase, information may also be passed from the station to the aircraft concerning any amplifying data that has been received about the search object. If the crew has not been previously briefed, the briefing will be given over the ICS by the pilot during this phase. Minimum reporting requirements are described in the *Communications Manual* (9). Additional reporting requirements may be stated in local station policy publications.

3.6. Determine If Initial Mission Area Has Been Reached. In the HH3F, a message is displayed to the pilots on the computer panel advising them of arrival at the programed destination. A LORAN fix may be used to determine arrival at destination in all but the HH52A aircraft. Other navigational means, such as dead reckoning, VOR, ADF, Doppler, or TACAN, may also be used by the pilot to determine that the desired point has been reached. (See Table 2 above.) In many cases, arrival may also be determined by direct visual sighting of the object and/or other on-scene craft. Upon arrival, the aviators prepare and transmit an initial situation report (SITREP). They then proceed to conduct the required search operations (4.0) or begin immediately to accomplish the indicated rescue operation (5.0).

4.0. Search.[1] This phase begins with the descent of the aircraft to the mission altitude. It includes the establishment and conduct of search procedures, equipment utilization, modification of procedures as necessary, and acquisition of and approach to targets for identification. The phase terminates either when the search has been successful (i.e., positive identification of the subject has been made) or when the search is suspended. As noted previously, not all SAR missions require search. If the object's location is known, for example, the aircraft will proceed immediately to perform the indicated recovery activities (5.0).

4.1. Descend to Mission Altitude. From the initial mission area entry point, the pilot controls the aircraft to descend to the search altitude. Typically, this will be between 500 and 1,000 feet for all aircraft, depending on search conditions (e.g., visibility, nature of the search object, sea state, other aircraft in the area). The copilot completes the descent checklist and assists the fixed wing pilot with flaps and instrument readings. In the HH3F, the barometric altitude control is disengaged prior to descent. If conditions require, the rotary-wing aviator may perform his descent to search altitude by accomplishing the "Beep-to-a-Hover" approach on instruments (see, for example, reference 5).

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[1]The discussion in this section emphasizes those searches wherein the object of the search is located below the rescue aircraft on the water or on land (shore, island) near the water. It does not consider fully the search activities involved in an intercept mission for FW aircraft. Briefly, on intercept missions the pilots plot the time and position of intercept (see 1.2) and depart the station on a course that considers the closure rates of the two aircraft on different headings and at an altitude that will place them in a favorable position for the intercept. If the aircraft is equal or lower in overall performance capability to the CG aircraft, the desired intercept posture is from behind and above the distressed aircraft. If it is of greater performance capability, the CG aircraft will fly out on course, turn at a predetermined point and allow the distressed aircraft to overfly him. "Search," in this case, is chiefly electronic, rather than visual. It features use of communications radios and associated direction finding equipment and use of the IFF interrogator group which presents pictorially the relative bearing of the other aircraft from the CG aircraft and gives a digital readout of distance. The TACAN air-to-air mode can also be used for ranging if the other aircraft is similarly equipped. Radar may be used for range and bearing, but its effectiveness is conditioned by the reflectivity of the profile presented by the other aircraft. "Rescue," in this case, involves escorting the aircraft to the first suitable landing site while being prepared to assist him in ditching if this should become necessary. The normal escort pattern places the CG aircraft above and behind the aircraft with observers positioned to detect leaks, fires, structural defects, etc.

4.2. Establish Initial Search Configuration. When ready to actively commence search activities, the pilot gives a final briefing to the crew concerning the characteristics of the object of the search, the distance between successive legs in the search pattern, procedures for reporting possible targets, when to deploy markers (smoke, flares, dyes), and scanning techniques. He positions his observers and establishes an on/off, side-to-side rotation schedule for the crew.

In the fixed-wing aircraft seats are installed at fixed locations on each side of the cabin for use by observers during search. To provide a greater field of view, special search windows and doors are used in these aircraft. In the HU16E, they are installed by the crew prior to the beginning of search operations. In the HC130B, after the Flight Engineer has depressurized the aircraft, the crew opens the paratroop doors and the search doors slide in. The HC130B flight deck also may be used as a search platform. When it is, observers sit on stools to look out the lower windows of the cockpit. The pilot and copilot also serve as observers from their respective positions.

The HHS2A conducts limited search operations (see 4.3), but when it does, the copilot and crewman serve as the principal lookouts. The copilot monitors the left side and the crewman the right. The hatch door may be opened to provide better viewing conditions. The pilot, flying the aircraft and monitoring the instruments, serves nonsystematically as a lookout.

In the HH3F, the pilot and copilot function as observers to the extent not precluded by their respective tasks of aircraft control and computer monitoring plus the joint task of instrument monitoring. In this aircraft, the radioman on the left of the aircraft and the SAR aircrewman on the right function as observers. The jump-seat in the cockpit door may also be used as an observer platform if an additional position is desired.

In all aircraft, when the aircraft and crew are ready for search, the pilot establishes his initial search heading, airspeed, and altitude. He then flies the initial leg of predetermined length. Subsequent legs are flown as dictated by the specific search pattern being flown. The HC130B pilot may feather the two outboard engines, one at a time, to conserve fuel and thereby permit longer endurance in the search area.

4.3. Conduct Search Activities. As noted in 1.2 above, the selection of the overall area in which to conduct search operations is based on consideration for the last known (or estimated) position of the object and its characteristics which, together with winds and currents, would determine its direction and rate of movement across the water over time. From this process a best position estimate (BPE) for the subject for a particular time is computed. Boundaries are selected around the BPE to define the likely area within which the object may be found.

Given the limits of the search area, a systematic procedure must be used in conducting the search. This insures that the total area inside is, in fact, examined, and in such a way that there is an acceptable probability that the subject will be located under the prevailing conditions. A variety of patterns have been developed for conducting search operations. These are summarized in Table 3 which has been taken from the National SAR Manual (2).

Table 3

SEARCH PATTERN SUMMARY

Pattern Designation	Type	Units Required	Remarks
PS	Parallel Track Single Unit	1 A/C or 1 ship	Search of an area when the position of the distress is unknown.
PL	Loran Line Parallel Track	1 A/C or 1 ship	Same as Plan PS except that unit uses LORAN lines for greater track accuracy.
PM	Parallel Track Multi-Unit	2 or more A/C or 2 or more ships	Same as Plan PS except that two or more units search in abeam formation at distance S apart for faster and greater area of coverage.
PP	Parallel Sweep	2 or more A/C or 2 or more ships	For use in search of a long rectangular area where only one sweep out and back is possible.
CS	Creeping Line Single Unit	1 A/C or 1 ship	For use when survivors or distress are reported to be between two points, but position is not known. Covers a wider area than track crawl plans.
CM	Creeping Line Multi-Unit	2 or more A/C 2 or more ships	Same as CS except that two or more units are used cruising abeam.
CSC	Coordinated Creeping Line Single Unit	1 A/C <u>and</u> 1 ship	For use when distress is reported between two points but position is not known; also used for track search. Coordinated for more accurate search tracks.
CMC	Coordinated Creeping Line Multi-Unit	2 or more A/C <u>and</u> 1 ship	Same as CSC except that two or more A/C flying abeam are used with ship.

Table 3 (Continued)

Pattern Designation	Type	Units Required	Remarks
CSR	Radar Coordinated creeping line single unit	1 A/C and 1 ship	Same as CSC except that ship controls A/C by radar to keep A/C on accurate search tracks.
CMR	Radar Coordinated Creeping Line, Multi-Unit	2 or more A/C and 1 ship	Same as CMC except that ships control A/C by radar to keep A/C on accurate search tracks.
CMCS	Split Coordinated Creeping Line	2 A/C and 1 ship	This plan differs from others in that aircraft work on opposite sides of ship.
TSR	Track Crawl Return single unit	1 A/C or 1 ship	For search of a track line, or line of position when unit must break off search at same end of track as originated on.
TMR	Track Crawl Return Multi-Unit	2 or more A/C or 2 or more ships	Same as TSR except that two or more units are used cruising abeam.
TSN	Track Crawl, Non-Return single unit	1 A/C or 1 ship	Same as TSR except that search terminates at opposite end of track from start point.
TMN	Track Crawl, Non Return Multi-Unit	2 or more A/C or 2 or more ships	Same as TSR except that search terminates at opposite end of track from start point, and two or more units are used cruising abeam.
SE	Expanding Square Single Unit	1 A/C or 1 ship	For use when position of distress of survivors is known within close limits and area to be searched is not extensive.
SEM	Expanding Square, Multi-Unit	2 or more A/C or 2 or more ships	Same as SE except that it is desired to employ several units in the same pattern but searching independently.

Table 3 (Continued)

Pattern Designation	Type	Units Required	Pattern
VS	Sector Single Unit	1 A/C or 1 ship	Object being searched for small and position of distress is known within close limits.
VM	Sector Multi-unit	2 or more A/C or 2 or more ships	Same as VS, but two or more search units are used.
O	Contour	1 A/C	For search of mountainous or hilly terrain.

The choice of a specific pattern and the distance between successive legs (track spacing) in the pattern is based on factors such as the size, shape, and color of the target, and sea and weather conditions. These factors affect the probability of detection of particular classes of search objects. The location of the sun, as it affects search, and the direction of water movement are considered in determining the direction of travel (line of creep) over the search area. The detailed procedures for selecting the search area and for choosing a specific search pattern are amplified in the SAR Manual (2).

Normally, detailed search planning is not a primary responsibility of the aviator (see 1.2 above). It must be considered, however, as a secondary responsibility since he may be required to assume this task at various times. The principal responsibilities of the aviator for search are to execute the plan. This involves his flying the aircraft at an appropriate altitude, maintaining the prescribed track spacing and otherwise managing his search resources (including observers, equipment, other search units as appropriate, utilizing ground facilities appropriately, etc.) in such a way as to both maintain the prescribed probability of detection of the subject and to complete expeditiously coverage of the assigned search area.

Careful attention to navigation is required to determine the aircraft's position in the search area, along each track, and between each successive leg (track).

As noted previously, search capabilities of the HH52A are limited. Basically, the aircraft is designed as a short-range recovery vehicle. It has limited fuel capacity and little navigation equipment. When used in search, it is generally confined to a sector search where a visual reference (e.g., a surface vessel, smoke marker, buoy, etc.) is available. It may also conduct shoreline searches traveling parallel to shore or on legs perpendicular to it. Direction finding capability is available in the HH52A only on LF and on HF (see 3.2).

The three other aircraft have more search and navigation equipment and greater endurance for search. Direction finding capabilities are available on all radio bands for obtaining bearings to targets. Radar is also available in these three aircraft. During search, especially search

under conditions of limited visibility, the on-board radar may be actively employed to locate the object of the search. The usefulness of the radar for this purpose is limited by the reflective characteristics of the object being sought. It may also be affected by the range and size of the target and the skill of the operator in tuning the radar and in interpreting the display images (e.g., being able to distinguish targets from the sea return). In the HU16E, the operator must also maintain the correct antenna tilt and orientation for effective scan of a designated area.

Normally, the radar is operated by an enlisted technician in the HU16E and HC130B. Aviators, however, may be required to operate the radar when no qualified technician is available. Functional control of the radar set is at the navigator's position in the HC130B. The cockpit, however, contains a repeater scope. The scope and associated controls are located at the navigator's position in the HU16E. In the HH3F, the scope and its controls are directly in front of the pilot and copilot. The copilot operates the system in that aircraft.

LORAN is also available on the HC130B, HU16E, and HH3F. LORAN is used principally for position fixing. It has been used, however, to locate vessels known to be situated along given LORAN lines. The LORAN may be operated by an aviator but normally is operated by an enlisted technician. The aviator, navigator, or copilot plots positions on LORAN charts. In the HH3F, the LORAN is operated by the radioman.

The value of LORAN is affected by the time of day at which fixes are attempted, and the quality of the coverage available in given geographical locations. The older sets are susceptible to electronic interference (e.g., lightning, other HF transmissions). These older sets also have a tendency to overheat. For this reason, a spare LORAN set is generally taken in the HU16E and the older HC130B flyaway kits if extended off-shore operations are likely. The newer LORAN A set installed in the HH3F and in some HC130Bs is easier to operate (i.e., requires less operator skill), and is less limited operationally than the older versions.

The HC130B uses doppler as a principal means of maintaining track position during search. The doppler may be updated by periodic LORAN fixes. The HH3F has an on-board computer which gives information on position within the track or search pattern from VORTAC, LORAN, manual DR or doppler inputs. ADF, VOR, and TACAN are also used for search navigation when they are available. These facilities are used singly or in combination to locate subjects, e.g., near VOR and/or TACAN radial intersections. They may also be used in combination with radar and/or DF "fixes." ADF has been used, for example, to fly outbound on an outer compass locator (OCL) to arrive at a scene where an inbound aircraft had disappeared from a radar scope. It is also used to intercept distressed aircraft for escort to safe landing. For intercept missions, the interrogator (HU16E, HC130B) is used to identify the aircraft and to obtain distance and relative bearing. Other navigation capabilities are described in Segment 3.2 above.

Improper utilization of resources and imprecise navigation may limit the effectiveness of the search. Other factors may also limit effectiveness. The aircraft structure, for example, will interfere with direct vision. Aircraft vibration, noise, and other variables affecting crew comfort may affect search efficiency. Motivational factors are also

important, especially in long duration searches. The type of target, its appearance, and prevailing visibility affect search efficiency. Observer scanning techniques, which include knowledge of what to look for (e.g., a calmer area inside waves may indicate an oil slick, a perpendicular patch of white against a horizontal white pattern may be a sail) are also important. Sea state will also enter into the probability of search being successful. For example, many boats may be difficult to distinguish from whitecaps or the subject may be momentarily hidden behind waves.

4.4. Accomplish Required Reporting. In addition to maintaining communications with the home station, with other craft in the search area, and, often, with the search object, the aviators are required to prepare and transmit situation reports (SITREPS). One SITREP is required when the aircraft arrives on scene and begins its search activities. Others may be required periodically on a time base or as events change. A standard format is followed for these reports. This is prescribed by the Coast Guard *Communication Manual* (9). Pilots prepare the information content and format the reports. They are then transmitted either by the copilot or by the radio operator. In some instances, the SITREP may be prepared by Operations from informal traffic passed to the home station (especially for the HH52A). If an on-scene commander (OSC) has been assigned to the area, participating units pass informal traffic to him which he uses to prepare the SITREP.

4.5. Obtain Contact With Possible Objective. Acquisition of targets may be through electronic means (radar, ADF), or through visual sighting. Once contact (or possible contact) has been obtained, positive visual identification is necessary. The pilot may be required to break off a search leg to check out sightings which possibly are the object of his search. If the next leg through the search area will carry the aircraft closer to the sighting, the preferred procedure is to identify the target on the next leg. Frequently, however, rather than risk losing contact with the sighting, the pilot will leave the track to effect an identification.

4.6. Initiate Approach to Objective. The usual procedure for leaving the track to check out sightings is for the pilot to displace the aircraft to the side of the crewmember who sighted the target. This provides for maintenance of the visual contact during the approach. A set turning procedure is not necessarily followed. A marker (smoke, beacon) may be dropped, or a LORAN fix may be taken prior to leaving the track to facilitate return to the original track position if the sighting is false. The usual procedure is for the pilot to use dead reckoning to the sighting, and to return to track on the reciprocal of the outbound course, making due compensation for winds.

4.7. Identify Target. In some cases, the identity of the target is obvious from its appearance (e.g., life raft, man in water, etc.). In other cases, an object, e.g., a fishing boat, may have to be picked out from a number of objects. With larger vessels, the name or number on the vessel may have to be read. For identification purposes, the FW pilot flies a long low approach to and over the object. The RW pilot establishes a hover or may land on the water. At night flares may be dropped. The crew and pilot also observe for obvious signs of distress (e.g., people waving or international distress signals). If identification is positive, the pilot will then instruct the crew to

prepare to render the indicated assistance (see 5.0 below), and report the finding to interested agencies (e.g., home station, other search aircraft).

4.8. Resume Search. If no positive identification is made (wrong vessel, faulty sighting), the pilot returns to his original position on the search leg to resume the search. It is possible for wind error to accumulate owing to imprecise navigational capability on the flight out to and back from the sighting. Consequently, gaps may be inadvertently left in the search area. Such error is minimal with the HC130B and HH3F, however, because of their doppler capabilities. Upon return to his original track position the pilot resumes the search.

4.9. Revise/Modify Search Procedures. For various reasons, it may be necessary to modify or revise search procedures. This may result from instructions from the RCC who has obtained amplifying data on the search object which places it in a different area, for example. It may be based on recomputations stemming from later reports of on-scene weather, winds, and currents. These would affect the best position estimate for the target. Also, information may be received, for example, that people are in the water rather than on a life raft as previously assumed. This would require adjustment of the track spacing and, probably, altitude to achieve a desirable probability of detection (POD) for the smaller object.

Frequently, the search procedures may require modification by the Coast Guard aviator directly. If he is serving as an OSC, he will have responsibility for coordinating the efforts of multiple units to insure coverage of, and achievement of a specified POD within, the search area. In the event that one or more of the units must leave the area, for example, the OSC may require extra legs by the remaining units (if their endurance will permit this), or he may adjust track spacing with RCC approval to complete the search area. Usually, he will assign search altitudes to other participating aircraft.

4.10. Suspend Search. Unsuccessful searches may be suspended after several hours, or after several weeks. The temporal length of the search is based on considerations for the probability of survival of an individual or vessel. If it is known that an overdue pleasure yacht, for example, was well equipped for survival, an active search may be carried on for several weeks. On the other hand, a search for an individual in freezing water without protective clothing would be suspended sooner. Decisions to suspend are made by the RCC based on all available, relevant information.

The individual aircraft commander may, however, request suspension of a particular search mission for a number of reasons. The sea state or on-scene visibility may effectively reduce the probability of detection below acceptable limits. Malfunctions may occur which are detrimental to the continued safety of the aircraft. Loss of the LORAN or doppler system when considerably off-shore may render the aircraft incapable of accurately determining its position for continued search. Fuel depletion or serious illness of a crewmember may also result in a request to suspend the search.

When an aircraft is departing the search area, the pilot will notify the OSC if one has been assigned. The OSC will notify RCC. If no OSC has been assigned, the pilot notifies RCC of his departure through his home station. If search is to be subsequently resumed by

another aircraft, either on the same or on the following day, the departing aircraft may drop a datum marker buoy for use by replacement aircraft in homing to the area.

5.0. Rescue/Recovery. This phase begins with the Coast Guard aircraft ready to take up the appropriate rescue or recovery activity. The crew is briefed on the specific role each member is to play and the pilot controls the aircraft to execute the recovery activity. The phase ends when the required assistance has been rendered at the distress scene or it has been determined that Coast Guard assistance is no longer required.

Because of the essential differences in rescue/recovery operations which stem from the basic differences in the capabilities of the two categories of aircraft, rescue/recovery activities of each are treated separately in this report.

5.1. Fixed-Wing Rescue/Recovery Activities. Fixed-wing aircraft effect rescue principally by aerial delivery of needed survival equipment. De-watering/fire fighting pumps are the most frequently dropped item and are standard SAR items on fixed-wing aircraft in some localities. They are routinely delivered to vessels taking on water. Fixed-wing aircraft may also effect recovery by intercepting and escorting distressed aircraft or by standing by a distress scene and orbiting until surface craft arrive. They may also assist rescue operations of other craft in a number of ways. In rare circumstances, the HU16E pilot may attempt a water landing to pick up individuals in the water, but recovery *per se* is not normally associated with the mission of Coast Guard fixed-wing aircraft.

5.1.1. Accomplish Aerial Delivery. The pilot prepares for the aerial delivery by establishing a racetrack pattern over and around the subject, with one of the legs overflying the subject directly, at an altitude of approximately 200 feet. He briefs the crew on his intentions and the procedure to be employed in executing the drop, including when to drop and how to deploy the trail line. Smoke markers may be dropped for estimating wind direction and velocities. Flying requirements and the drop pattern are described in the SAR Manual (2).

The point of a drop within the pattern is determined by the object being dropped, the method of dropping (i.e., free fall or parachute), and/or by vessel and wind considerations. Parachute drops (e.g., a pump) are most frequently downwind if the drift of the distressed vessel is faster than the drift of the object dropped. This allows the vessel to overtake the package. If the vessel has power, the object is normally dropped upwind. Sea Rescue Kits (i.e., MA-1 Kits) are normally dropped (free fall) crosswind. The procedure employed allows the line connecting the two rafts to trail out and drift in a somewhat "U-shaped" fashion to partially encircle individuals in the water.

In the HC130B, drops are accomplished on pilot command out of the cargo ramp. In the HU16E aircraft, drops are accomplished on pilot command from the door of the aircraft. A trail line frequently is used in accordance with pilot instructions. The crewman or loadmaster follows visually the progress of the parachute and reports to the pilot its impact position.

5.1.2. Accomplish Aircraft Intercept/Escort. A form of rescue activity for Coast Guard fixed-wing aircraft is the interception of aircraft in distress (e.g., an aircraft which has reported an engine out).

The procedure followed in this instance is for the pilot to head toward the distressed aircraft on a heading that will provide maximum coverage of the inbound track and which will thereby place him in a favorable position for the intercept. He will normally be in communication with the distressed aircraft. He intercepts the aircraft principally through use of his radio communications, ADF, and through use of the IFF interrogator. Radar may be used.

Once rendezvous with the distressed aircraft has been effected, the Coast Guard aircraft will escort it to a suitable landing site. The services given by the Coast Guard aviator to the intercepted aircraft are advisory. His communications will request the distressed aircraft to advise the Coast Guard pilot of his intentions. The Coast Guard pilot will then establish a position above (1000') and behind (3 miles) the distressed aircraft. This places the Coast Guard aircraft in a "ready" position for immediate assistance if ditching is required (see 3). Visual contact will be maintained insofar as this is possible. The Coast Guard pilot may be required to evaluate sea state conditions and to otherwise assist the distressed aircraft in ditching procedures. He may also drop flares to illuminate the sea lane and advise the distressed aircraft on appropriate ditching headings. If ditching is not required, the Coast Guard aircraft escorts the distressed aircraft to the first suitable landing site. (See footnote to 4.0.)

5.1.3. <u>Provide Rescue Assistance</u>. Frequently, the fixed-wing aircraft, rather than directly accomplishing a recovery, assists in it in various ways. For example, the FW pilot may orbit a distress scene until a helicopter or surface vessel arrives to effect recovery. There is no set procedure for such orbiting. The pilot simply establishes a pattern which will allow continuous viewing of the object or result in his passing over it at periodic intervals. He may establish a circular or a racetrack pattern around the target. Smoke floats may be dropped alongside the subject for continued visual reference. While orbiting, the FW pilot utilizes his communications to direct other craft to the scene.

Fixed-wing pilots also frequently assist in the recovery activities of other craft in other ways. The fixed-wing pilot, serving as OSC, may coordinate the rescue activities of vessels or other aircraft (see 4.9 above). He may also assist by establishing radio relays and otherwise serving as a high altitude communications/navigation platform. He may drop flares to illuminate the recovery area for surface vessels or for helicopters to accomplish their recovery activity.

5.1.4. <u>Accomplish Water Landing</u>. The HU16E aircraft commander may, in cases of extreme urgency, request authorization from the Coast Guard District Commander to accomplish an off-shore water landing (1). At the present time, such landings are not accomplished operationally. Sheltered water landings are, however, made for training purposes and by Sangley Point HU16Es for LORAN resupply. The procedures for water landings and take-offs as they differ from land operations are described in the HU16E Standardization Manual (8).

5.2. <u>Rotary-Wing Rescue/Recovery Activities</u>. Rotary-wing rescue/recovery activities are accomplished from a hover or by landing. Rescue may be effected by hoisting while hovering or by dropping equipment from the hover. Landing on the water or in confined areas is considered routine for the helicopters and they may also engage occasionally in towing boats.

5.2.1. Establish Hover. To establish his hover under good visibility, the RW pilot controls the aircraft to fly a normal approach into the wind. Under poor visibility or at night, the beep procedure contained in the HH52A Standardization Manual (5) is used to establish a hover at forty feet. Essentially the same procedure (i.e., "pattern") is used with the HH3F, except the hover terminates initially at 50 feet.[1] Timing and airspeed are different for the two aircraft.

To accomplish the beep procedure, the copilot sets the low altitude warning light on the radar altimeter, observes the area outside of the aircraft providing pertinent call-outs to the pilot, and otherwise serves as safety pilot staying "visual" until the pilot can establish visual contact. If visual contact has not been established from the initial hovering altitude of 40 feet, the HH52A pilot slowly descends to 30 feet by reference to the radar altimeter. In the HH3F, the copilot engages the coupler on pilot command and, after the hover is stabilized, the pilot uses the altitude knob to lower the aircraft slowly to 30 feet while cross-checking against the radar altimeter. If visual contact with the surface below is not made by the copilot at this altitude in either aircraft, the pilot performs an instrument take-off and leaves the area. If visual contact is made, the pilot then "goes visual" and proceeds to maneuver the aircraft for hoisting or landing on the water.

At night the copilot turns on the hover floodlights and the pilot may direct the crewman to use the Aldis lamp to illuminate the area below. Approaches to a hover under low illumination are difficult to manage because of limited depth perception under such conditions. Pilots have noted that a "milk-bowl" effect is created by salt spray activated by the rotor and illuminated by the helicopter lights at night, a condition which is hazardous to safe operations. This condition is more severe for the HH3F than for the HH52A because of the HH3F's more powerful rotor downwash.

5.2.2. Accomplish Hoist Operations. The hoist checklist (pilot and crewman) will normally be completed prior to the approach, and rigging of the basket (or other device) will have been accomplished. If the hoist is to be made from a vessel, communications (when appropriate) will normally have been established with the vessel, and a standard pre-hoist briefing informing the vessel crew of the helicopter's intentions and the actions required of the vessel will have been given.[2] If communications could not be established, the pilot may attempt use of a message block, chalkboard, or hand signals to pass instructions. If these fail, he proceeds to make the hoist anyway.

Hoists may be accomplished with three pieces of equipment: rescue basket, litter, or sling. The rescue basket is preferred. The

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[1]A forthcoming revision to the HH3F Flight Manual will contain the complete standardized procedure for this aircraft. Further information on this procedure is presented in Section 4 of this report.

[2]Normally, the Coast Guard District radio will have relayed instructions to the vessel concerning handling of the rescue gear prior to the helicopter's arrival on scene. Otherwise, an escort aircraft may accomplish this.

Stokes litter is generally used only in cases where distress of the patient is such as to preclude use of the basket. The litter is generally hard to handle on retrieval. It has a tendency to spin and must be turned by the crewman to guide it past the sponson in the HH52A and to keep it from going under the bottom of the HH3F. It will only fit into the hatch end-wise which requires further manipulation. Although the basket also requires guiding and handling, it does so to a lesser extent. A sling (horsecollar) may be used to recover individuals, especially from the water. Its use, however, for safety reasons (it is possible to fall out while being hoisted), is chiefly limited to rescue of military personnel trained in its use. The basket may be used to retrieve people two at a time (e.g., when a boat is sinking rapidly).

When hoisting from a boat, the pilot approaches the vessel from the stern and hovers momentarily 15 - 20 yards short of the vessel. The pilot makes his power checks, trims the aircraft, checks the wind and instructs the crewman. The crewman opens the cabin door, lets the basket down on the hoist cable, and may dip the basket into the water to discharge any accumulated static electricity. The crewman raises the basket partway up, and the pilot flies to the hoist position over the vessel as directed by the crewman.

The hoist operator in both helicopters plays an important role in establishing and maintaining the final hover position. From the cabin door, the hoist operator has direct visual access to the object below. When ready to establish the hover for accomplishment of recovery activities, the pilot turns off all of his radios except the ICS. The crewman goes on the "hot mike" for direct communications with the pilot. He directs the pilot to make small corrections to maintain the position near the vessel from which he desires to effect the hoist.

In an attempt to obtain a better visual reference on a vessel and also to minimize rotor downwash effects on the vessel, the pilot may elect to accomplish a hoist from an offset hover position (left and aft of the hoist point). This is done by dropping a trail line to the vessel. The hover is established so that the vessel is out of the wash and the trail line is used to pull the basket onto the deck. Likely, this type of hoist will be more prevalent with the HH3F than with the HH52A because of rotor wash considerations.

Selection of hover altitude for accomplishing a hoist is based on a number of considerations. Sometimes the height used is a personal preference of the aviator. At other times, it is based on consideration for factors such as the weight of the aircraft and density altitude which affect hovering capability; height of mast or highest point of the vessel; winds; and sea state. Adequate consideration must also be given to the effects of the rotor downwash on objects on or in the water. The downwash, being more pronounced for the HH3F, generally means that this aircraft must hover higher than the HH52A unless the relative wind speed across the target is high.

Often, especially if a vessel is small, the pilot may be unable to maintain a satisfactory visual reference against which he can judge his hover. Pilots report that they use a piece of bow, sometimes framed in a selected portion of the windscreen, for visual reference, or they may fly against lights on the vessel (e.g., masthead light) at night. This lack of adequate visual reference is the most serious difficulty

involved in hoisting operations. Night operations simply compound the problem. The less the availability of visual cues for the pilot to use for a reference, the greater must be his reliance on auditory cues from the crewman to maintain his position relative to the vessel from which a hoist is being made.

To minimize the effects of the rotor downwash on the vessel from which the hoist is being made, it is preferred that the vessel be underway with the wind 30 - 40 degrees off the port bow. This both increases the relative windspeed across the vessel and also gives the pilot a larger portion of the vessel to use as a visual reference when hovering over it. Because of the forward velocity of the vessel and the motion induced by sea conditions, the "hover" has a forward velocity component, may have a lateral velocity component, and pitch, roll, and heave components. The pilot, rather than hovering, flies formation on the vessel, responding in kind to the changes in position of the vessel. In the HH3F, active control of the helicopter to maintain relative position is minimized by the doppler coupler which exercises automatic control of the hover in all axes except yaw.

Problems of relative motion are involved for the pilot in maintaining his position over a vessel. Relative motion is, of course, also a problem for the hoist operator located on one moving platform attempting to position the basket on a second moving platform on the water.

Although both helicopters have hoist switches in the cockpit, hoist is not usually accomplished from the cockpit. At some Air Stations, however, the procedure is practiced against the possibility that a crewman at some time may not have full use of both hands (e.g., broken arm). In this instance, the crewman still provides conning information to the pilot.

5.2.3. Accomplish Drop Operations. Drop operations are accomplished in rotary wing aircraft from a hover position. If a message block is to be dropped, the pilot will establish a hover over the object, and the crewman will drop the block. If a pump is involved, it will normally be lowered to the deck on the hoist cable unless rough sea conditions indicate that this procedure might cause damage to the vessel. If this is the case, the pump will be dropped into the water, and a weighted trail line attached to the pump will be dropped to the vessel or draped across its bow. The trail line is used by the vessel's crew to haul the pump aboard. Drops of other equipment may also be made by using the hoist cable or by lowering it on a rope.

5.2.4. Accomplish Water Landing. When wind and sea conditions permit (e.g., direction of swell and winds are favorable, and waves are not more than five to six feet with an acceptable period between them), the rotary wing pilot may elect to land on the water to accomplish a rescue operation as an alternative to hoisting. Water landings are routine at most Air Stations. This procedure is most often elected when individuals are in the water or on small boats or rafts. It may also be used to inspect or identify pieces of debris.

Under good visibility conditions, the pilot makes a normal approach to a hover to effect the landing. If the water landing is being performed at night or under marginal visibility conditions, the pilot employs the beep procedure to establish visual contact with the surface below. If an object/individual is to be retrieved from the water, the

crewman opens the hatch door and installs the rescue platform during the approach and upon instruction from the pilot. From the hover altitude (approximately 20 feet in the HH52A, higher in the HH3F), the pilot lowers the aircraft to the water, exercising caution on control of attitude to prevent the tail rotor from striking the water. In the HH3F, greater care must be exercised in lowering the aircraft because of its higher gross weight and greater inertia.

Two procedures are followed to rescue persons in the water. When the sea is rough, it may be necessary to maintain lift on the rotor so as to avoid damage or flameout. In this case, the pilot maintains lift on the rotor while touching the water rather than coming to a full landing. Under these conditions, the pilot "lands" the helicopter with the distress object inside the rotor wash and as near to the platform as possible. The approach, or "water taxi," is directed by the crewman, who assists any distressed individual aboard. If the sea is calm, the pilot lands the aircraft with the object outside the rotor wash, partially unloads the rotor, and water taxis toward the individual. This procedure reduces the rotor wash on the distress object.

Normally, an instrument take-off from the water will be accomplished if adequate visual references are not available. If the sea is rough, the helicopter heading is maintained up to 90 degrees out of the wind in order to parallel the existing swell (the angle is in part a function of the tail rotor clearance needed). If the sea is relatively calm, the pilot may elect to ride the trough. In any event, forward velocity is kept to a minimum on water, thus minimizing the possibility of ingesting water into the engine(s). On take-off, the pilot lifts to a hover of 20 feet in the HH52A and around 50 feet in the HH3F before transitioning to forward flight. More complete detail on water operations is contained in the HH52A Standardization Manual (5) and in the HH3F Flight Manual (4).

5.2.5. Accomplish Confined Area/Shipboard Landing. Frequently, the HH52A rotary-wing pilot will be required to make confined area landings as part of a SAR mission. Such landings may be aboard a strange vessel (e.g., merchant vessels) or one of the larger Coast Guard cutters (210-foot or 378-foot), on a landing pad attached to an oil rig, in a parking lot, at U. S. Public Health Service hospitals, or in other restricted clearings. Chiefly, these landings occur for the purpose of medical evacuation of distressed persons. In such cases, depending on the visibility conditions, the copilot must serve as lookout for the pilot while he accomplishes the approach to a hover and vertical let-down. Chief hazards include wires, buildings, towers, ships' masts, riggings, and similar obstructions. On strange ships, the pilot may be required to land among the riggings by estimating visually the rotor clearances.

Landings on Coast Guard cutters are usually made for purposes of refueling so as to prolong endurance on a SAR mission. The landing procedure requires the cutter to maintain a heading with the wind approximately 20 degrees off the port bow so that the aircraft may approach into the wind. The pilot flies over the vessel with parking brake set if a landing grid is not available, matches the speed of the vessel and its movement characteristics (thus, relative to the vessel, he establishes a hover), and accomplishes a positive, i e , firm, let-down onto the deck. A Landing Signal Officer (LSO), when available, signals the landing instructions to the pilot A vertical take-off under direction of the LSO is

accomplished The HH52A may land on cutters of the 210 class or larger. The heavier HH3F can land only on the 378-foot cutter which has greater deck stressing. Development of an in-flight refueling capability for the HH3F is under consideration

5.2.6 Accomplish Boat Towing. Under current regulations, rotary-wing pilots may assist boats by towing them only if a hand-held line that can be quickly released is held by the crewman. The procedure is for the pilot to move the helicopter laterally for short distances only. This operation is considered hazardous and is not often accomplished.

6.0. Return Cruise Profile. This phase begins when assistance of a particular Coast Guard aircraft has been determined to be no longer required, or when the aircraft is no longer able to render assistance (see 4.10 above). It may involve no more than a climb to cruise altitude and enroute navigation back to the home station If the aircraft has operated from an intermediate airfield, it may involve a return to that airfield first before returning to the home station. Any of the tasks in this phase may be performed a number of times under a number of circumstances before the final leg back to the home station actually begins. The phase terminates with the aircraft near the home Air Station ready to begin his descent.

6.1. Accomplish Take-Off as Required. If a landing has occurred during deployment on a particular SAR mission, the aircraft crew will perform the tasks described in Segments 1.5 through 2.4 above as they are relevant and required

6.2 Establish Climb Configuration. If no landing was involved before the return to station, the pilot will break off the search operation when it is appropriate to do so (e.g., completion of assigned area, inability to continue), notify RCC through the station or the OCC, and advise the crewman to secure over the ICS. The copilot will accomplish the necessary tasks (e.g., raise flaps) to transition the aircraft from the search configuration to a ready-for-climb configuration. In the HC130B, the flight engineer and/or copilot, on pilot command, restarts the two idle engines. The pilot, assisted by the copilot monitoring relevant instruments, begins and maintains his climb to the desired return altitude

6.3 Establish Return Cruise Profile. Upon reaching the desired altitude, the pilot levels off the aircraft. The copilot and/or flight engineer assists as required The copilot and/or radioman tunes radios to the appropriate initial enroute navigation facilities and communications frequencies The copilot may also prepare a SITREP advising termination of activities for transmittal to the home station. Usually, this is transmitted by the radio operator in fixed-wing aircraft and in the HH3F and by the copilot in the HH52A.

The copilot or third aviator on extended FW search missions will determine the aircraft's present position from plots kept during the mission or from use of available navigational aids, e.g., LORAN or TACAN. He will then determine an appropriate return course, using relevant flight publications, weather information, and fuel remaining. After determining a flight plan, the copilot may call the appropriate air traffic control agency directly or transmit the information to the home station for relay to controlling agencies if controlled airspace is to be utilized (see also 3.1) or air defense zones penetrated. On the return flight, the aircraft

crew may also be instructed to maintain a lookout for objects of previous searches. If endurance factors permit, the aircraft may be diverted to a new SAR case while enroute.

6.4. Perform Enroute Navigation. During the return cruise, the pilot maneuvers the aircraft to establish his initial heading to the home station. He may set the auto-pilot (in fixed-wing aircraft) to fly the aircraft on its return course. In cruise, the HH52A is always flown with the ASE engaged and the HH3F with the AFCS engaged. The pilot maneuvers the aircraft as required to correct for winds and to effect required course changes. He transitions as appropriate to enroute navigation facilities. The navigation capabilities, facilities, and techniques used here are the same as those described in Segment 3.2 above.

6.5. Monitor Aircraft/System Status. Both the pilot and the copilot monitor engine, flight, and navigation instruments enroute to determine if the aircraft is operating normally within the desired/required flight envelope Crewmembers perform aircraft security checks. The HC130B flight engineer monitors the status of all on-board systems. (See 3.3 above.)

6.6. Accomplish Required Reporting. SITREPS prepared by the copilot may be transmitted during this phase. Also, Operations Normal reports will be transmitted at least every 30 minutes to the station by the copilot in the HH52A, and by the radiomen in the other aircraft. (See 3.4 above.)

6.7. Determine Destination Airfield Descent Area Has Been Reached. The pilot/copilot determines that the initial point for beginning the descent to the airfield has been reached by reference to the appropriate navigational instruments, by reference to navigational plots maintained by the copilot, or by radio/radar contact. TACAN or combinations of VOR, ADF, and DR navigation may also be used for this. Because of the location of Coast Guard Air Stations near the shore, visual sighting of the shore serves to identify the descent point if such descent is permitted by the flight plan. The pilot may continue to the airport or other landing site by visual reference to ground objects and terrain or by instrument navigation.

7.0. Approach and Landing. This phase begins with the completion of the preliminary descent checks and with the establishment of the appropriate descent configuration. It includes the activities of the pilot and copilot in transitioning to the appropriate instrument approach facility, or in performing VFR approaches to the airfield. Landing is accomplished. The phase ends with the aircraft on the ground, having completed its landing roll.

7.1. Begin Descent. The copilot assists the pilot by performing the preliminary descent checks. The pilot manipulates the aircraft power settings and control surfaces as appropriate to establish the desired descent configuration. The copilot tunes and identifies navigational facilities and communicates with appropriate ground stations. Transition to the instrument approach facility and/or to Approach Control is effected as appropriate.

7.2. Accomplish Prescribed VFR or IFR Approach. Under VFR conditions, the pilot accomplishes his approach and landing as instructed by the tower. In the absence of a control tower, the pilot will determine the approach and landing configuration appropriate for the prevailing conditions and act accordingly. Under IFR conditions, the pilot continues

his descent into the airfield boundary, using an available instrument approach system, until visual contact is made. At certain Air Stations, lack of instrument facilities (e.g., Salem) may require that the pilot land at an alternate airfield. This is usually at a nearby military field having more complete instrument facilities.

7.3. Execute Landing. The pre-landing and landing checklists are completed by the copilot during the approach. Wheels are let down (except the HH52A) and the FW crewman checks visually that the wheels are down and locked. The appropriate airspeed and flaps (for fixed-wing aircraft) settings are established and the aircraft touches down. Brakes are used by the pilot to slow the aircraft, and the landing roll is completed. Rotary-wing aircraft may execute a running landing or may land vertically from a hover over the runway or pad.

8.0. Postflight. This phase involves moving the aircraft from the runway to its parking area. It also includes the completion of post-flight checks, aircraft shutdown, and securing of the aircraft. Preparation and submission of required reports and stowing of SAR gear is also accomplished during this phase.

8.1. Taxi Aircraft to Parking Area. After bringing the aircraft to a full stop, the pilot taxis the aircraft to its designated parking area.

8.2. Complete Postflight Checks and Secure Aircraft. The pilot, copilot, and crew complete the postflight checklists as applicable for each of the aircraft. The tasks required are contained in the respective Operator's Manuals for the aircraft (4, 5, 6, 7, 8). The engines are shut down, parking brakes are set, and the rotor brake is set in the HH3F and HH52A. The ground crew accomplishes the tiedown of the aircraft and may begin preparing it for its next flight.

8.3. Accomplish Required Reporting. At the conclusion of the flight, the pilot annotates the appropriate forms to record the history of the flight, notes discrepancies, and records SAR gear expended. A final SITREP noting arrival time at the station (plus other information not previously transmitted) is prepared by the pilot for transmittal to RCC.

NAVY AND COAST GUARD FLIGHT TRAINING

Approximately 90 percent of all Coast Guard aviators receive their initial flying training from the U. S. Naval Air Training Command (NATC). These aviators require further training within the Coast Guard to become operationally proficient in Coast Guard aircraft and mission requirements. How much and what kind of training is actually needed depends upon the skills and knowledges that they already possess by virtue of their prior training. This section examines NATC training to identify aviator input level, skills and knowledges. It provides data that may be compared to operational mission requirements to reveal the further training required to become operationally proficient.

The section focuses principally on the new aviator. It briefly examines the trainee input process and the nature of the training which the new aviator has experienced prior to his entry into the Coast Guard to receive training for operational assignments. For completeness in deriving training requirements for Coast Guard aviation, the training that he may receive while holding an operational billet is also considered. The second part of the section briefly recounts the training which may be given qualified aviators by the Coast Guard during or preceding operational tours.

The main body of the text does not consider the second major source of Coast Guard aviators. Hence, it is mentioned briefly here. Each year eight to ten aviators who have flown operational tours with other military services are selected by the Coast Guard to receive direct commissions. These individuals are assigned directly to a Coast Guard Air Station (CGAS). From there, they are sent to Yorktown for Coast Guard indoctrination. Upon their return to the Coast Guard Air Station, they receive (usually) transition training into a Coast Guard aircraft. If the aviator is fixed-wing qualified, he transitions to either the HU16E or the HC130B. If rotary-wing qualified, he transitions to the HH52A helicopter. If he is dual qualified (i.e., fixed wing and rotary wing), the Commanding Officer will exercise his option on aircraft assignment for training. Coast Guard training programs are further described in later pages of this section.

NAVY TRAINING

To determine the ability levels of aviators newly entering the Coast Guard, NATC was visited and information was obtained concerning each flying training experience the student aviator receives. Figure 2 shows the sources of Coast Guard trainee inputs to the NATC program and the aviation training which they receive within NATC. In the discussion, each block of the figure is amplified to describe the objectives of each flying training experience and the methods by which training was conducted. The discussion is specific to the aviator who is destined for the Coast Guard. It does not exhaustively consider the U. S. Navy-destined aviator who receives certain additional training to prepare him for his subsequent Navy role.

COAST GUARD AVIATOR TRAINING WITHIN THE NAVAL AIR TRAINING COMMAND

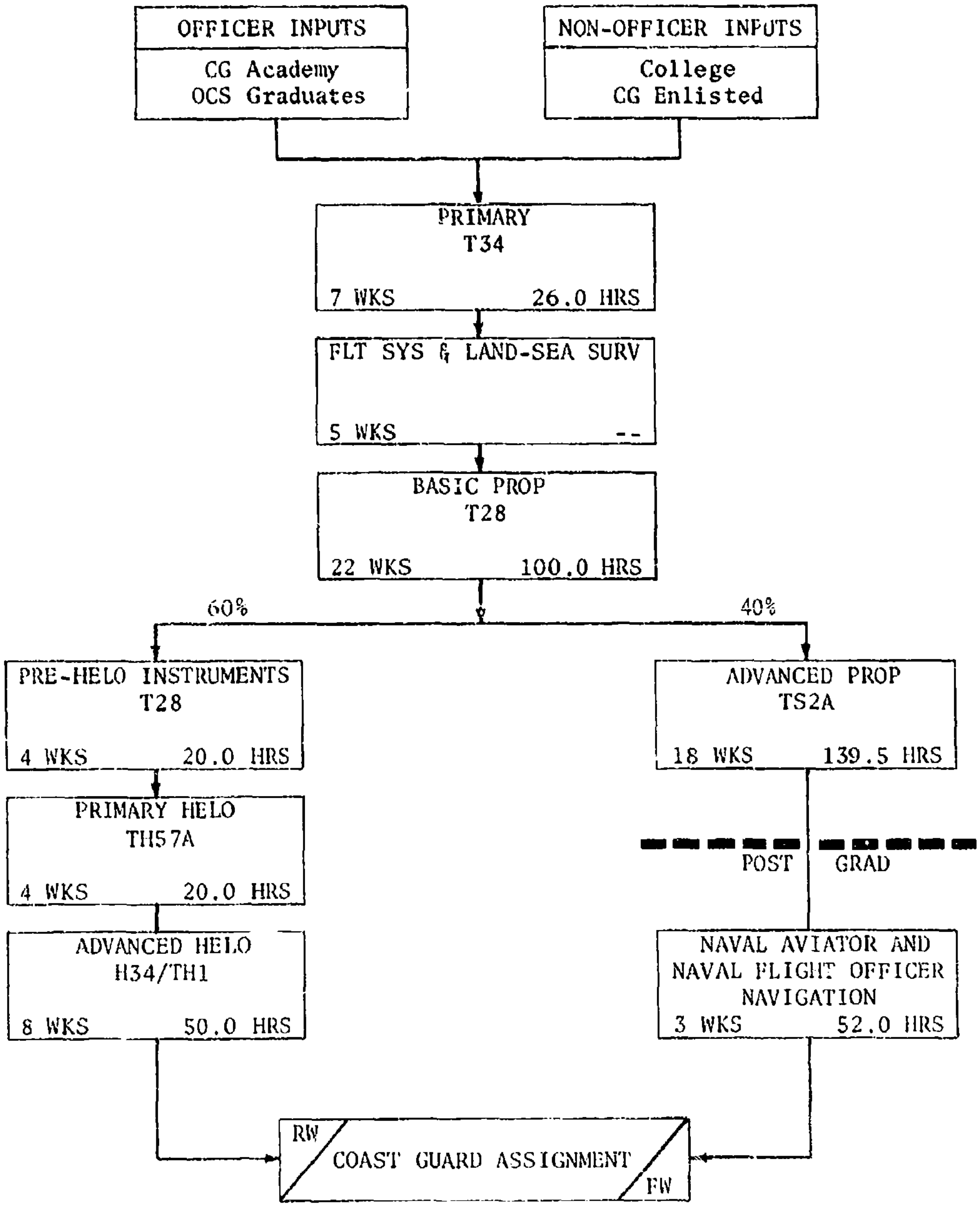

Figure 2

NATC Initial Aviator Training

Inputs. Commissioned officers who are physically qualified and under 28 years of age may be accepted for pilot training. Individuals not holding commissions may be accepted as Aviation C ts if they are 19 - 25 years old, have one year of college or the eq .ivalent, and meet the physical standards. Approximately 36 Coast Guard officers and 10 Aviation Cadets are scheduled to enter the flight training program in FY 1969 - 1970. Aviation Cadets are commissioned if they successfully complete the flight training program. If for any reason a cadet fails the program, he reverts to enlisted status and is required to complete two years total service including the time spent as an Aviation Cadet.

Primary Training. Non-officer students complete a two-week Aviation Officer Candidate Indoctrination Course prior to entering primary flight training. Officer students enter the program directly. Primary consists of 26 hours of flight training which is given over approximately seven weeks.

All primary flying training is given in the T-34B aircraft. This is a single-engine, all metal, low-wing, two-place tandem seated monoplane with retractable tricycle landing gear. Manufactured by the Beech Aircraft Company, it is powered by a 0-470-4 Continental engine. Primary flying training is given in two stages: Pre-Solo and Precision.

The Pre-Solo Stage consists of 11 dual instructional flights, one check flight and one solo flight. The student is instructed in the fundamentals of good airmanship, with emphasis on the principles of attitude flight, coordination of controls, smoothness, basic airwork, effective use of trim tabs, and landing techniques. The student is also taught stalls and spins, entry, recognition and proper recovery techniques.

The Pre-Solo Stage is supported by ten hours of flight support (academic training) instruction in flight fundamentals, aircraft taxiing techniques, emergency procedures, safety, field patterns, field and area assignment and rules; and a pre-solo briefing and examination.

Prior to the first flight period of the Precision Stage, the student receives one hour of flight support (academic training) instruction concerning the maneuvers that he will practice during this stage. The Precision Stage consists of three dual and three solo flights. The sixth flight is a final checkride on all maneuvers introduced in the Pre-Solo and Precision Stages. During the Precision Stage, the student receives instruction in and practices: precision landings, precision spins, accidental spin recovery, unusual attitudes, wingovers, loops, and power-off spirals. Barrel rolls, Cuban eights, Immelmans, and inverted stalls are demonstrated.

Primary flight training is supplemented by ground training in a T-34 cockpit procedures trainer and a T-34 bail-out procedures trainer. Students are required to complete this ground training prior to the first period of actual flight.

The cockpit procedures trainer duplicates the T-34 cockpit interior. Each student is required to complete three and one-half hours of instruction in the device. Instructional emphasis is placed on the function, location, and operation of cockpit instruments and equipment. This

includes canopy operations and control locking devices, flaps, landing gear, and checklists. The student must pass a blindfold check in the device and a written examination on the material.

The bail-out procedures training is an actual T-34 aircraft. It is secured to the ground in a cruise flight attitude. A net is mounted alongside the aircraft. Students are instructed in the proper bail-out procedures and are required to make two jumps into the net: one without slipstream and one with the engine turning up 2,000 RPM to provide a slipstream.

Flight Systems and Land-Sea Survival. After successful completion of the T-34 portion of the program, all students next receive flight instruction in the T-28 aircraft. Before proceeding to the T-28 program, however, the student pilots complete a five-week instructional unit called "Flight Systems and Land-Sea Survival." This is an academically oriented program and no flight instruction is given during this phase of training.

The first four weeks are devoted to subjects common to aviation in general. The topics presented include Basic Aerodynamics, Elementary Air Navigation, Aviation Physiology, Meteorology, Power Plants and Accessories, Mathematics Orientation and Physics Orientation. The last week of instruction is on land-sea survival techniques. Overall, this course consists of 20 hours of classroom instruction with examinations, six hours of laboratory and field instruction, eight hours of practical experience in deep sea survival and two days of practical experience in a land survival exercise.

Basic Propeller. All students next receive 100 hours (66.3 dual and 33.7 solo) of flight training in approximately 22 weeks in the T-28B aircraft. The T-28B is a single-engine, two-place tandem seated, all metal monoplane with retractable tricycle landing gear. Manufactured by the North American Aircraft Company, it is powered by an R-1820-86 reciprocating engine. The aircraft is larger and mechanically and electronically more complex than the T-34 used during primary training.

During the Basic Propeller Phase, flight training is presented in eight stages: Transition, Precision/Acrobatics, Basic Instruments, Radio Instruments, Formation Flying, Night Familiarization, Day Navigation, and Night Navigation. In addition, 65 hours of flight support (academic training) are presented. The flight support program includes two hours of training in cockpit procedures. This is given in the T-28B procedures trainer. The training covers the location and function of the cockpit components and allows the trainee to practice the various checklist procedures (e.g., prestart, start, and runup). Flight support training also includes 22.8 hours of basic instrument and radio instrument training. The instructional training is given in the T-28B (Device 2B21) synthetic instrument trainer. It covers attitude instrument flight control and VOR, ADF, and GCA approach and navigation procedures in the 2B21.

After successful completion of the basic propeller phase, U. S. Coast Guard aviators receive further training in either propeller-driven fixed-wing aircraft or in rotary-wing aircraft. Current Coast Guard requirements dictate that approximately 40 percent of the

student aviators emerge from the NATC program qualified in fixed-wing aircraft. The other 60 percent become rotary-wing qualified. Normally, these requirements are met by volunteers for the specific category of training.

Advanced Fixed Wing Training

Coast Guard students, who are pursuing fixed-wing qualification, proceed to the U. S. Naval Air Station, Corpus Christi, Texas, for advanced propeller aircraft training. Potential rotary-wing aviators remain at Pensacola.

Advanced Propeller Training. The advanced propeller training course is approximately 14 weeks long. Coast Guard students receive 125 hours of flight training. All flying training is conducted in the TS-2A aircraft. This is a twin reciprocating engine, high-wing monoplane built by the Grumman Aircraft Company. The operational version of the aircraft (TS-2A) is used principally for anti-submarine warfare.

Training is conducted in four stages:

1. Alpha. This is principally an aircraft familiarization stage. It consists of seventeen and one-half (17.5) hours of pilot and three and one-half (3.5) hours of copilot flight time. The student transitions into the aircraft and receives a VFR, daylight checkout in the TS-2A. Instruction is given on the aircraft's systems and its flight characteristics. Training is also given on aircraft operations and emergency procedures.
2. Bravo. Bravo Stage consists of 43.5 hours of instrument training. This phase is a complete instrument course. It begins with basic instrument instruction and proceeds through advanced radio navigation. Air Traffic Control (ATC) procedures utilizing all facilities, voice communications, approaches, and emergency procedures are practiced.
3. Charlie. Charlie Stage involves 15 hours (8.7 pilot time and 6.3 copilot time) of night familiarization flying. In this stage the student practices night take-offs and landings in the TS-2A aircraft, performs night cross-country flights (using IFR and VFR techniques) and practices emergency procedures.
4. Delta. Delta Stage consists of 45 hours of flight training (25.3 as pilot and 19.7 as copilot). This is a tactical orientation (day and night) course. The student receives instruction in, and practices, formation flying and low altitude precision maneuvering and visual navigation utilizing over water and over land techniques. Six hours are devoted to over water navigation practice.

The advanced propeller syllabus is supported by 45.6 hours of flight support training. This consists of: 14.5 hours of lectures on flight procedures for the TS-2A aircraft; 6.8 hours practice in the TS-2A procedures trainer, and 24.3 hours of synthetic instrument training in the 2B13A trainer. All synthetic training must be completed prior to the first flight in the aircraft.

A range of training is conducted in the TS-2A procedures trainer. Procedures covered are pre-start, start, pre-taxi, engine runup, take-off,

post-take-off, pre-landing, landing, post-landing, secure, fire on start, wing-fold malfunctions, taxi emergencies, engine failure on take-off, runaway propeller, engine failure at altitude with restart, fire in flight, electrical malfunctions, landing gear malfunctions, hydraulic emergencies, and runaway trim tabs.

The student learns and practices his responsibilities for the procedures as both pilot and copilot in the procedures trainer and in the aircraft. Synthetic instrument training in the 2B13A parallels the instrument flight practice given in the aircraft.

Upon completion of the advanced propeller phase, U. S. Coast Guard students are graduated as rated fixed-wing aviators. Aviation Cadets are also commissioned. The Coast Guard student graduates with approximately 250 hours total flight time.

Navigation Training. After completion of the U. S. Navy Aviator Flight Training Program, the Coast Guard fixed-wing aviator is required to attend the Naval Air Advanced Training Command's "Naval Aviator and Naval Flight Officer Navigation" course at the Naval Air Station, Corpus Christi, Texas. This course is three weeks long for the Coast Guard aviator. The aviator receives 52 hours of inflight navigation training (no aircraft control time) consisting of:

1. Sixteen hours of day point-to-point celestial navigation. This includes familiarization, use of celestial lines of position and wind stars, celestial sights, dead reckoning navigation, drift reading, no-wind plotting, radio bearing, and log and chart keeping.

2. Eighteen hours of night point-to-point celestial navigation which features night practice of the techniques and procedures listed above.

3. Six hours of shipping surveillance. This flight is designed to introduce the student to a typical patrol type mission requiring accurate DR navigation. Radio fixing is accomplished using any previously learned methods: i.e., celestial, radar, LORAN, or radio aids.

4. Six hours ASW/SAR. Essentially the same type of practice as noted immediately above is given. In addition, two types of geographic search, the geographic square and the parallel sweep search (ladder search) ar flown. C'ose course control is stressed.

5. Six hours patrol. On this flight, the student constructs and flies a patrol pattern for a designated area. He makes use of all previously learned tactics and techniques. Electronic-countermeasures are introduced.

The last three flights (i.e., 3, 4, 5 above) are normally flown over water except for the search patterns introduced on the ASW/SAR flight. These flights also may be flown either day or night.

Rotary-Wing Training

U. S Coast Guard students who are to receive rotary-wing training enter into such training after completion of the basic propeller syllabus. All helicopter pilot training is conducted at the Naval Air Station, Pensacola, Florida.

Pre-Helicopter Instruments. The first course for the helicopter student pilot is "Pre-Helicopter Instrument Training." The course is four weeks long and includes 20.0 hours instrument flying time in the T-28B aircraft. The purpose of the course is to provide advanced fixed-wing instrument flight training for the helicopter student pilot.

The course includes a review of basic attitude instrument flight techniques under full and partial panel conditions. Additional instruction is given in ATC procedures: voice communications; ATC clearances; departure procedures; enroute navigation; holding, arrival, approach, missed approach; and emergency procedures. VOR and ADF navigational and approach systems are used.

Flight instruction is supplemented with eight hours of instruction in a synthetic instrument trainer, Device 2B21. This is being increased to twelve hours. Insofar as is practicable, students are scheduled to practice material in the 2B21 just prior to an applicable flight. If a student fails a period in the 2B21, the Squadron is notified. If he fails the subsequent flight in the aircraft, he receives a two-hour review in the 2B21 and then receives a recheck in the aircraft.

After completion of the pre-helicopter instrument flight course, the rotary-wing student pilot receives helicopter training at Ellyson Field near Pensacola, Florida. The student receives a total of seventy hours of flight instruction in two helicopters. Helicopter training is divided into four stages: Primary, Advanced, Operational, and Instruments. The last three stages occur in the Advanced Helicopter Program.

Primary Helicopter Training. In the Primary Stage the student receives 20 hours of flight instruction in the TH-57A aircraft. The TH-57A is a single-rotor, two-bladed helicopter with a turboshaft engine, skid-type landing gear and dual flight controls. Manufacured by Bell Helicopter Company, it is powered by a single 250-C18 Allison engine.

In the Primary Stage the student is taught the fundamentals of helicopter flight. He learns the preflight check, cockpit check, starting, runup and shutdown procedures; helicopter flight controls, RPM control; hovering, vertical, forward, and sideward flight; turns, climbs and descents; air taxi and air taxi procedures; clearing turns and emergency procedures. Of the 20 hours of flight training, the student flies 3.6 hours solo.

Advanced Helicopter. In the Advanced helicopter training program the student pilot completes the remaining three stages of training in either the TH-34 or the TH-1 helicopter.

The TH-34 is a four-bladed main rotor and tail rotor helicopter with two main wheel landing gear and a small tail wheel. The aircraft is equipped to carry external sling loads. Manufactured by Sikorsky Aircraft Company, it is powered by one R-1820-84A engine. The TH-34 aircraft is being phased out of the training program as procurement permits its replacement by the TH-1 helicopter.

The TH-1 aircraft is a single-rotor, two-bladed helicopter shaft-driven by a gas turbine engine. Torque is counteracted by a two-bladed tail rotor mounted on a tail boom. The aircraft, manufactured by Bell Helicopter Company, is powered by a T53-L-11 engine.

In the Advanced Stage the student pilot transitions from the TH-57A into the TH-1 or TH-34. He learns flight handling characteristics and receives 15 hours of flying training. Flying training is all dual.

During the Operational Stage the student learns the operational capabilities of the helicopter. He is given 15.5 hours of flight training in which he practices performance of operational missions. Training exercises include maximum load, rough terrain, hydraulic hoist, and external cargo operations. Training missions are flown both during the day and at night.

The final stage of training is the Instrument Stage. The student pilot completes 19.5 hours of flying training in which he learns to adapt his fixed-wing instrument skills to rotary-wing aircraft. The flying training begins with basic attitude instrument flying and progresses through radio navigation, ATC procedures, departures, clearances, approaches, holding, missed approaches, and emergency procedures.

The Advanced Helicopter flying training program is supported by 21.5 hours of flight support subjects in addition to academic subjects. The flight support includes 6.5 hours of instrument flight training in a synthetic instrument flight trainer (Device 2B18 which simulates the TH-1E helicopter). All synthetic training must be completed before the student starts the instrument phase.

Elimination Procedures

If a student fails a checkride at any point in the program, his record is reviewed by his Flight Instructor, the Flight Leader, Flight Operations Officer, and Training Officer. Any of these individuals may recommend elimination. The usual procedure, however, is that they recommend one or two (maximum) extra flight periods and a recheck. If the student fails a recheck, the Squadron Commander convenes the Student Pilot Disposition Board. This Board may award up to two extra periods and a recheck or it may eliminate the student. Over 50 percent of those appearing before this Board are recommended for elimination. The number of students disposed of in this way, however, is small.

Qualities of Graduates

At the completion of the NATC program, the aviator is a competent pilot although lacking in in-depth experience. He has been awarded a military instrument rating. He understands basic navigational techniques and principles and has learned to apply these in the training aircraft. He is apparently not well-qualified in low level over water instrument work nor in SAR procedures. The fixed-wing pilot has no experience in executing aerial drops to the surface of the water nor is he familiar with techniques for operating the aircraft on water. Similarly, the rotary-wing pilot has had no water work and no experience in hoisting from a boat moving over the water. He is also deficient in operating from confined areas. In the next section training requirements are presented which more fully delineate training required upon the aviator's entry into the Coast Guard.

COAST GUARD TRAINING

The Coast Guard aviator leaves NATC qualified in either FW or RW aircraft. At this time, he is assigned directly to a Coast Guard Air Station. He may then enter into a training program at the Air Station or he may be sent to the Coast Guard's Training Section (TRASEC) at Mobile, Alabama, for further training.

Within the Coast Guard, the aviator generally begins his flying career by transitioning into the same aircraft category (FW or RW) as the one in which he holds his initial entry qualifications. Thereafter, he may be exposed to a number of different flying training experiences both for general proficiency training and for SAR proficiency training, as well as for transitioning to new aircraft or qualifying in the other category. The major categories of aviator training within the Coast Guard are described briefly below.

Transition Training

The objective of transition training is to qualify an aviator already qualified in one type aircraft within a category into a new aircraft of the same category (i.e., FW to FW or RW to RW). In most instances, transition training programs are designed to qualify the transitioning pilot as a copilot in the new aircraft. Transition training may be accomplished either at TRASEC or at the Coast Guard Air Station. No set policy determines the locus of training.

HH3F Transition Training. For initial site activation, HH3F transition training was given HH52A qualified aviators by TRASEC instructors at specific Coast Guard Air Stations. Present plans are that all subsequent HH3F transition training will be given at TRASEC only. The principal input to the transition program will continue to be seasoned CG aviators already holding HH52A designations--although newly designated (by NATC) rotary wing aviators may be transitioned into the aircraft. Currently, transitioning pilots are given 36.0 hours of flight instruction (aircraft control time) and log an additional 16.5 hours of special crew time in the program.

HH52A Transition Training. Transitioning of RW designated aviators to the copilot level in the HH52A aircraft may be accomplished either at TRASEC or at the aviator's unit of assignment. Normally, inputs to the program are newly designated RW aviators from NATC. Direct commission RW aviators may, however, be transitioned to the HH52A. The transition program at TRASEC provides 31 hours of flight training. HH52A transition training programs at the various Air Stations provide varying flight time ranging from 7.5 hours to 47.5 hours.

HU16E Transition Training. HU16E transition training is treated similarly to HH52A training. It may be given the new FW aviator at his station or at TRASEC. Twenty-five hours of flight instruction are given at TRASEC. Flight hours range from 9 hours to 24.5 hours for copilot designation at the various Air Stations.

HC130B Transition Training. Inputs to HC130B training may be new FW aviators or pilots designated in the HU16E. No HC130B transition training is given at TRASEC. This is handled by the Air Stations in various ways.

(1) The transitioning pilot may receive all of his transition training, including ground school, at the station prior to designation as a copilot. Probably 10 - 15 hours flying time will be given.

(2) He may receive some of his training at the station with additional training purchased from the Marine Corps or from the Air Force.

The El Toro (California) Marine Air Station provides ground school training plus 30 hours of C130E simulator training. This is devoted principally to the practice of procedural aspects of flying the C130E. Flight training is given at his home station and the differences between the C130E and HC130B are acquired by the aviator from study of the flight manual.

Sewart Air Force Base conducts a formal course of training which includes ground school, 30 hours of C130E simulator training which emphasizes procedures, and 45 hours of C130E flying training. A quota for 12 Coast Guard pilots per year is available from the Air Force. Depending largely on time considerations, the student pilot may transition into the HC130B at his home station, fly operational missions as a copilot and subsequently be assigned to Sewart for the formal course. This will occur before he receives a first pilot (FP) designation.

Qualification Training

The overall objective of qualification training is to qualify an aviator already rated in one category of aircraft (e.g., RW) into the other category (i.e., FW). All stations and TRASEC may conduct qualification training to designate RW aviators as copilots in one of the fixed wing aircraft. Qualification training of fixed wing aviators to RW aircraft may, however, be accomplished only at TRASEC (1). In addition to providing training for control mastery of the aircraft, additional training is usually required to prepare the aviator for acquiring an instrument rating in the new category of aircraft in accordance with the provisions of the *Coast Guard Air Operations Manual* (1, paragraph 303). If instrument training is not given during qualification training, it is subsequently given as part of the first pilot syllabus at the Air Station. Inputs to qualification training programs generally are experienced Coast Guard aviators acquiring dual qualifications (i.e., designated in both categories of aircraft).

HH3F Qualification Training. Currently no qualification training is given in the HH3F aircraft. Plans are that FW aviators will first qualify in the HH52A aircraft, fly it operationally, and subsequently transition, depending on service needs, into the HH3F.

HH52A Qualification Training. All HH52A qualification training is accomplished at TRASEC. The present program of instruction features 78 hours of flight instruction plus academic instruction on the aircraft's systems.

HU16E Qualification Training. Usually, HU16E qualification training is conducted at the individual air station. It may also be conducted at TRASEC where 88 hours of flight training are given.

HC130B Qualification Training. This training is conducted in the same way as transition training which is described above. TRASEC currently has no facilities for HC130B training.

Upgrade Training

Upgrade training is conducted for assigned aviators at all Air Stations. Its objective is to prepare the aviator for progressively higher designation in type. The typical progression[1] is copilot (CP) to first pilot (FP) to aircraft commander (AC) in the particular type aircraft. Requirements for designations are stated in the *Air Operations Manual* (1). They are summarized briefly here.

For CP designations in type, the aviator must hold a valid instrument rating, complete a transition or qualification course as described above, and complete a written examination concerning communication procedures, federal air regulations, local flight rules, and standard SAR equipment.

For FP designation, the aviator must have fulfilled the requirements for CP designation, hold a valid instrument rating in the category of aircraft involved, and have not less than 500 hours' total pilot time. He must also complete a locally prepared flight syllabus (see above for HH3F transition training) and a written examination covering:

- SAR directives and publications
- Technical directives and publications
- Pertinent CG Manuals
- Commandant's instructions
- Weight and balance
- Cruise control and fuel management
- Ground security of aircraft while away from home unit

Before being designated as a first pilot in type, the student aviator must demonstrate his flying proficiency to a check pilot. This includes the following specific items as they are applicable to the aircraft involved:

- Ground and water handling
- All normal flight maneuvers (day and night)
- Instrument operations
- Emergency procedures
- Maximum performance maneuvers
- Assisted take-off for FW aircraft
- SAR procedures and techniques
- Cruise control and fuel management

For aircraft commander designation, the aviator must have fulfilled all requirements for CP and FP designations. The FW aviator must also have at least 900 hours total flight time with 250 hours in fixed-wing aircraft. The RW aviator must have at least 700 hours total flight time, with 150 hours in rotary-wing aircraft. He must also complete a locally prescribed flight syllabus and complete a written examination covering:

- The *Air Operations Manual*, CG 333, (1)
- *National SAR Manual*, CG 308 (2)
- *Aircraft Emergency Procedures over Water*, CG 306 (3)

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[1]For initial activation of HH3F units, HH52A aircraft commanders were transitioned as HH3F aircraft commanders rather than to the CP level as would normally occur.

- All current unit and district directives and commandant's instructions
- Relevant technical data and publications
- Applicable operations and communications plans

In addition, the aviator upgrading to aircraft commander must demonstrate the ability to:

- Exercise flight discipline and aircrew supervision
- Execute all types of SAR missions, including duty as on-scene commander
- Execute all other types of missions normally performed by the unit

A flying proficiency check is also required before aircraft commander designation. This includes demonstration to a check pilot of proficiency in SAR procedures, instrument procedures, emergency procedures, and maximum performance maneuvers with the aircraft.

Local commanders may expand on the basic requirements as necessary to insure required levels of aviator proficiency for that station. Training sessions for upgrading aviators are scheduled and conducted when time and personnel are available. Both the instructors (who must be designated as Aircraft Commanders) and the trainees fly operational SAR assignments during the same period that training occupies. Training in this case is sporadic rather than systematic and generally requires a length of time coincident with the trainees acquiring the necessary number of flying hours for the higher designations. The number of flying hours for upgrade training varies by aircraft and by station.

Recurrent Training

However designated, all Coast Guard aviators on active flying assignments are required to fly a minimum number of hours annually for training and a minimum number and mix of instrument approaches (1). These are normally flown at the station.

Flight Checks

The flight checks prescribed by the *Air Operations Manual* (1) may also be considered as training experiences. These include annual instrument flight checks and standardization flight checks.

All aviators prior to issuance or renewal of an instrument rating must successfully complete an instrument flight check in each aircraft category in which he is designated. He must demonstrate to a member of the unit's Flight Examining Board a degree of skill which is commensurate with the requirements of the Federal Airways System and Coast Guard Operations.

All pilots holding FP or AC designations must also successfully complete annually a standardization flight check in each type aircraft in which he is designated. The purpose of the check is to insure that the pilot is maintaining his basic aeronautical skills using approved standard procedures. The standardization check is basically the same as the FP or AC designation flight check with emphasis on emergency procedures and maximum performance maneuvers. If the unit has a primary SAR mission, the FP and AC must also complete a SAR procedures standardization flight check annually. The purpose

of this check is to insure that the individual pilot is maintaining his ability to execute procedures that may be required for the successful prosecution of SAR missions. Frequently, the two checks are combined into a single flight for pilot demonstration of required proficiency to a member of the unit's Flight Examining Board. Where non-standard procedures or flying deficiencies are observed, corrective suggestions are made.

Standardized flight checks may additionally be conducted by TRASEC instructors. Annually, these instructors visit the various air stations to observe inflight the aviator's control of the aircraft and performance of SAR procedures. If time is available, the TRASEC instructors will fly with all assigned aviators. If it is not, their standardization visits will focus on performance by members of the unit's Flight Examining Board and its watchstanding aviators. These visits also provide opportunity for rotary-wing aviators to practice maneuvers (e.g., full autorotations) which are otherwise prohibited.

TRAINING REQUIREMENTS

This section is concerned with training requirements for Coast Guard aviation. The essential question of interest is, "What must Coast Cuard aviators learn in order to be proficiont SAR pilots?" The answer to this question may be found by comparing the skills and knowledges of pilots entering a given training program with those required for subsequent proficient performance of SAR missions. This section delineates and discusses aviator training requirements based on these considerations.

INTRODUCTION

The summary description of the SAR mission reveals that the Coast Guard pilot must be highly skilled in aircraft control. He must respond quickly and appropriately to a variety of rapidly changing external events. Performance of aircraft control tasks must be time-shared with a variety of other functions such as decision making and supervisory activities, performance of normal and emergency procedures for the aircraft, and accomplishment of navigation and communications tasks. The aviator must make decisions for his own aircraft and frequently for other craft participating in a given operation. In addition, he must possess a considerable array of background information relating to operation of the aircraft, SAR equipment characteristics, and SAR procedures. From this background he must be able readily to retrieve specific items to bring to bear on aspects of particular SAR cases for decisions concerning continuing or altering given courses of action.

The immediately preceding section described briefly the skills and knowledges of aviators newly entering the Coast Guard from the Naval Air Training Command. As a group, these aviators lack in-depth flying experience, and have had very limited exposure to SAR operations. Nevertheless, they have learned basic control relationships for aircraft within a given category, are generally knowledgeable in flying performance requirements for that category of aircraft, and hold a valid military instrument rating.

As an overview of this section, the principal training required for these new aviators is concerned with learning power plant operation, normal and emergency procedures and, in general, the response and handling characteristics of the new aircraft plus learning aircraft control for the accomplishment of SAR maneuvers. They must also acquire background knowledge for SAR planning and SAR accomplishment and otherwise acquire expertise for operational flying. For seasoned aviators undergoing transition or qualification training within the Coast Guard (i.e., converting their skills for flying aircraft of a new category), the training required falls essentially into the same categories, with the probable exception of the requirement for instruction to acquire background SAR knowledge. For the fixed wing aviator converting to rotary wing aircraft, additional time will be required to learn basic control relationships and control dependencies of rotary wing aircraft so as to make coordinated and smooth control inputs for the performance of SAR maneuvers. For the aviator upgrading in type aircraft, the principal training job is concerned with provisions for guided practice for the progressive refinement of his

aircraft control skills for specific purposes and/or acquisition of the necessary experience base for effective decision making in the operational situation.

The remainder of this section discusses Coast Guard aviation training requirements. At the outset, it should be noted that there is no *one* set of training requirements for Coast Guard aviation. The minimum number is the product of the number of positions to be filled in the aircraft and the number of aircraft types in the inventory.

Development of the specific instructional programs that will be required for training aviators for specific duties in aircraft is not within the scope of the present study. Rather, its purpose is to analyze Coast Guard aviator training requirements in order to determine functional requirements for flight training devices or simulators necessary to support the Coast Guard flight training program. In considering what the desired (or required) characteristics of synthetic flight training equipment should be, cognizance has been given to existing training programs in which synthetic equipment might be used as well as to possible future training programs that might be devised. Consequently, the training requirements described in this report are intended to stand as pillars for Coast Guard aviation training from which subsets of more specific terminal performance objectives may be derived for subsequent use in training program development.

The training requirements information presented in this section was developed in the following way. First, a composite listing of the tasks required of aviators to perform SAR missions was compiled. This listing emphasizes the common elements of performance across the four SAR aircraft. Specific performance variations required as a function of the particular aircraft were, however, identified. Also, performance variations that arise as a function of situational elements (e.g., condition or nature of the object of the SAR operation and the specific SAR procedure required and environmental influences on performance) were considered. Wherever possible, standards for performance were identified. Skill and knowledge requirements and aviator interactions with equipment and personnel were also identified. This composite SAR task inventory is presented below.

The task inventory was used as a basis for identifying six broad categories of training requirements. These categories are discussed in the text in terms of component skills requiring training and in terms of inclusion in transition, qualification or proficiency training programs. The trainee's previous aviation experiences were considered in discussing the specific training programs. The requirements are also considered in the light of "best" mode of training for their accomplishment, i.e., academic, synthetic, or flight training. These latter considerations were largely made on a judgmental basis stemming from the previous background experience of the research team in aviation training, simulation capabilities and uses, and training technology. Assistance in making these judgments was also provided by a consultant of the Institute of Aviation, at the University of Illinois.

SAR TASK INVENTORY

Table 4 summarizes the tasks involved in the performance of SAR missions. Column 1 delineates the essential behaviors which a Coast Guard aviator must exhibit to perform the tasks. Equipment, materials, etc.,

Table 4

COMPOSITE SAR TASK INVENTORY

Task	Cues/Equipment Involved	Comments/Qualifications
1. Receive notice of required SAR flight.	--	Notification may be given on ground or over communications radio if aircraft already airborne.
2. Obtain available information about case from local operations.	--	Coordinate with Operations Officer for type of case, nature of distress.
3. Determine location of distress area from data available.	Identify location on aeronautical charts, maps.	If already in flight, receives location information over radio.
4. Obtain information concerning local, on-scene and enroute weather.	Read and interpret weather maps or verbal or written weather summaries.	Coordinate with operations or local weather center.
5. Evaluate weather data for implications for flight and/or ability to execute required SAR procedures.	Correlate weather information with aircraft weather capabilities.	Consider extremes of temperature, effects of wind, humidity, precipitation, rough air, etc., on aircraft performance capabilities. Visibility restrictions. Requires knowledge of weather capabilities of the specific aircraft and the effects on aircraft performance of different weather conditions.
6. Determine aircraft/crew performance requirements to accomplish required mission.	Compute fuel required, weight of aircraft. Order extra or less fuel. Read and interpret aircraft performance tables in flight manual.	Coordinate with engineering section, ground crew. NOTE: fuel load computation may not be required at some air stations.
7. Devise initial flight plan and/or revise flight plan as required.	Use charts to identify optimum routing for conditions. Identify enroute navigational facilities, alternate airfields, mandatory reporting points. Location of warning or restricted zones, etc.	--
8. File flight plan.	--	--
9. Plan search. Review imposed search requirements or - Plan search accomplishment. - Define search area and compute boundaries. - Select appropriate search patterns. - Determine best direction of travel through/in search area.	Develop or revise plan in accordance with CG 308 (2). special instructions. Assure plan considers all pertinent factors that will affect search.	Consider size, type of object; rate and direction of object movement on water over time; sun, wind lines; object visibility characteristics; on-scene weather and visibility; sea state, day/night operation and other factors which will affect POD. Specific knowledge of aircraft capabilities for the specific operation is required. Knowledge of capabilities of SAR gear (e.g., flares for night operations) is required.
Plan aircraft intercept mission. - Determine location of distress. - Plot intercept position and time.	Review CG 306 (3) for ditching procedures. Review published ditch heading information.	HU16E and HC130B aviator requirements.
10. Plan rescue.	Review case data. Determine if confined area landing will be required. Determine adequacy of standard SAR gear or order other gear.	If rescue via HU16E is required, obtain required authorization before take-off. Consider requirement for JATO bottles.

(Continued)

Table 4 (Continued)

Task	Cues/Equipment Involved	Comments/Qualifications
11. Compare aircraft/crew capabilities with mission requirements. Conclude feasibility of accomplishment or initiate modifications to plan.	--	Coordinate with operations, SMC as required.
12. Review/recall OSC duties if a requirement of the mission.	Ascertain operating radio frequencies to be used on scene. Obtain identity of other units.	--
13. Assure aircraft ready for flight.		
- Verify fuel loading complete.	Check quantity.	Coordinate with ground technicians/operations.
- Check weight and balance of aircraft.	Determine values. Compare with flight manual to identify possible effects on aircraft performance.	
- Check all required equipment available.	Determine operating status of all necessary equipment-read maintenance sheets. Assure all SAR gear on board and properly stowed.	Coordinate/supervise crew members.
14. Perform preflight checks.		
- Perform exterior inspection.	Inspect exterior structure of aircraft checking for visible leaks, security of inspection doors and panels and presence of foreign matter (e.g., snow, ice) in accordance with flight manuals.	Supervise copilot and crewmen. Verify completion. NOTE: Complete inspection may have been accomplished previously by ready crew.
- Perform interior inspecttion.	Check cargo, seats, miscellaneous equipment secured.	Supervise crewmen.
15. Brief crew if required.	Briefing statement to be read to crew, may be provided. Briefing may be given later over ICS.	--
16. Assure all crew members in place.	Check visually and/or by ICS.	--
17. Perform before-starting engine procedure.	In accordance with flight manual: Check personal gear, verify all switches and controls in proper position or set as required/desired.	Coordinate with copilot/crew as appropriate. HC130B: Coordinate with flight engineer.
18. Perform engine starting procedures.	In accordance with flight manual, use starters, boost pumps, speed selectors, etc., as required.	HC130B: coordinate all actions with flight engineer. Start with internal or external power as required.
- Land.	Monitor engine instruments for correct indications. Use correct starting sequence for multi-engine aircraft. RW aircraft: engage rotor observing wind velocity restrictions.	Note temperature effects on engine start times/indications. Perform engine emergency procedures if required. HH3F: perform emergency rotor engagement procedures as required.
- Water.	In accordance with flight manuals for HH52A and HH3F.	May be required for both RW aircraft (see above).
19. Perform Before-Taxi Procedures.		
- Check aircraft ready for movement.	Lock pins, wheel chocks, ground static wire removed.	Coordinate with ground crew.
- Perform checklist items.	Check/set radios, controls, instruments as required by respective flight manuals.	Coordinate with crew.

(Continued)

Table 4 (Continued)

Task	Cues/Equipment Involved	Comments/Qualifications
20. Taxi aircraft.		
- Land.	Perform taxi checks in accordance with flight manuals.	Condition taxi procedure for high gross weights, wind from any direction with variable intensity.
- Water.	Perform in accordance with flight manual/standardization instructions.	HU16E, HHS2A, HH3F aircraft: Observe wind direction, waves, direction of swell, obstacles in water. Coordinate actions with copilot.
21. Receive take-off instructions/clearances from control tower.	Communications radio(s) tuned to tower frequency.	--
22. Execute take-off.	Perform required power/instrument checks in accordance with flight manuals. Adjust power.	Type of take-off is conditioned by visibility, land versus water, gross weight, density altitude for helicopter, clearances available, wind direction, velocity.
Rotary Wing Aircraft - Land		
a. Normal take-off to a hover.	Establish low hover. Check engine instruments, flight controls and CG trim. Maintain heading with pedals. Increase airspeed. Coordinate controls. Adjust power to establish rate of climb. Perform in accordance with flight manual.	Perform at moderate gross weights and altitudes.
b. Perform maximum performance take-off.	Check wind direction and area clear. Increase collective smoothly to maximum power to climb vertically or nearly vertically. Monitor clearances visually.	Perform when operating from restricted areas where obstructions surround the site. Requires sufficient power to hover out of ground effect. Training for shipboard operations required. In operational setting, pilot may attend to LSO hand signals.
c. Perform running take-off.	Turn helicopter into wind, lower collective to minimum, advance throttles, increase collective and apply forward cyclic to start ground run and obtain take-off speed. Use pedals to maintain directional control during ground run. After translational lift attained use cyclic to become airborne and increase collective for maximum power. Establish climb.	Perform under conditions of high gross weight and high density altitude. Attempt only on smooth surfaces and into wind.
d. Perform crosswind take-off.	May be performed same as other take-off with qualification of displacing cyclic into the wind.	Crosswind take-off prohibited where wind excessive.
e. Perform instrument take-off.		Perform when visibility restricted by precipitation, low ceilings, night time or dust, snow or water being blown by rotor downwash.
(1) Normal instrument take-off.	Align helicopter with desired take-off heading. Use collective smoothly to attain hover. From hover, change pitch, apply power and maintain level bank attitude. Cross check vertical velocity indicator and altimeter for positive climb indications	

(Continued)

Table 4 (Continued)

Task	Cues/Equipment Involved	Comments/Qualifications
22. Continued.		
	while accelerating. Reduce power and adjust attitude to maintain best rate of climb airspeed.	
(2) Running instrument take-off.	Perform similar to running visual take-off until airborne, then follow procedure above.	
Rotary Wing Aircraft - Water		
a. Normal take-off.	Adjust controls to accomplish vertical lift-off to hover.	Frequently will be accomplished as an Instrument Take-off. Use caution to avoid water ingestion into engine(s). Running take-off from water may be made under emergency conditions.
b. Establish take-off hover as applicable.	Perform power checks following procedure detailed in flight manual. Read Ng, Nf, torque.	
Fixed Wing Aircraft		
a. Initiate take-off roll.	Advance throttles, steer aircraft down runway.	Observe visually for hazards on runway. Adjust take-off run for high gross weight. JATO may be used if necessary. Observe wind direction/velocity.
b. Execute water take-off (HU16E only).	Coordinate controls. Use power differentially to maintain directional control.	Observe visually for hazards, water conditions. Qualify procedures for different intensities, and directions of wind. Coordinate closely with copilot.
23. Transition to forward flight.	RW: Use cyclic to obtain forward speed from hover. FW: Read take-off speed attained.	Perform emergency procedures as required.
24. Establish climb configuration.	Monitor all instruments for proper indications. Refer to climb data in flight manual for best climb airspeeds.	--
25. Perform post-take-off procedures.	In accordance with flight manual for the aircraft.	--
26. Monitor area outside aircraft.	Observe visually for hazards.	--
27. Tune communications/navigation radios as required.	Use radio control heads to tune to appropriate frequencies. Adjust volume controls. Identify stations from appropriate publications.	May require coordination with radioman depending on communications band(s) used. HH52A copilot normally performs communications tasks.
28. Communicate with control tower/operations as required.	Report departure details. Request departure instructions, clearances, weather data.	--
29. Request/receive departure instructions as appropriate.	Communications radios plus adjust controls to assume required altitude, airspeeds, headings.	--
30. Determine initial cruise altitude reached.	Monitor altimeter.	--
31. Level off at desired altitude and airspeed.	Adjust controls, trim aircraft. FW: Set autopilot.	Winds aloft.
32. Turn aircraft to initial heading as noted on flight plan.	Adjust controls to accomplish desired turning procedure.	Winds.

(Continued)

Table 4 (Continued)

Task	Cues/Equipment Involved	Comments/Qualifications
33. Continue cruise.	Monitor engine, flight instruments. Adjust controls as necessary to maintain course.	Winds aloft from variable directions, intensities, rough air, gusts. NOTE: Crew may be required to maintain lookout for object of prior searches.
34. Perform enroute navigation.		
a. Perform radio navigation. Tune radios to appropriate facilities, identify facility, adjust aircraft controls to follow radials, make necessary wind corrections, identify navigational intersections, identify station passage, report as necessary. Maintain data on aircraft position.	TACAN, VOR, ADF receivers and associated instruments. Communications radios. Use power/controls to change aircraft states, positions as necessary. Monitor flight, engine, navigation instruments. Plot positions on appropriate charts.	TACAN not installed in all HH52A aircraft. Note HH52A VHF communications limitations when VOR is used. Make appropriate wind corrections.
b. Perform automatic navigation (HH3F). Program computer for destination and alternates if not done previously. Select appropriate inputs, read out positional data.	Navigation computer and map display unit.	Pilot may use map display unit to provide position information on map (permanent copy may be scribed). Doppler navigation available, through computer only.
c. Use navigational features of flight director group for steering, heading data.	See flight manual for HH3F, HC130H. Make necessary control adjustments.	
d. Fix position by LORAN readout.	Request LORAN readout from radioman, plot on LORAN chart to determine position.	Not available in HH52A.
e. Accomplish navigation by reference to external visual features (pilotage).	Identify landmarks, terrain features for position information. Control aircraft to track terrain features for navigation purposes.	
f. Perform radar navigation.	Locate prominent land features by radar. Correlate with map data.	Radar not currently available in HH52A. Radar may also be used for search or weather surveillance. Operated by aviator routinely only in HH3F.
g. Perform dead reckoning navigation.	Use clock, keep time, distance, track.	
h. Use auxiliary navigation capabilities.		
- Receive DF steers from other craft.	Communications radios, adjust controls to assume required headings.	
- Receive radar vectors from ships, ground radar stations.	Communications radios, adjust controls to assume required headings.	
- Take bearings with aircraft radio direction-finding capabilities.	Communications radios, adjust controls to assume required headings.	
- FW: Use IFF interrogator group to locate distressed aircraft as appropriate.		
i. Perform doppler navigation.	Front instrument panel.	Coordinate with navigator to update doppler.

(Continued)

Table 4 (Continued)

Task	Cues/Equipment Involved	Comments/Qaulifications
35. Determine aircraft has arrived at initial mission area descent point.	Read position plots, navigational computer (HH3F) for arrival information. Sight other craft.	--
36. Prepare and transmit SITREP.	Draft arrival message for transmission over communications radio to operations in accordance with CG 233 (9) requirements.	Coordinate with radioman to send message. Static, attenuation of radio ranges.
37. Brief crew on mission requirements.	ICS, briefing checklist as appropriate.	--
38. Descend to mission altitude. - Descend visually, or perform instrument descent.	Perform predescent checklist for the particular aircraft. Adjust controls to descend. Monitor engine instruments. Monitor safe rate of descent, attitude indicator, etc.	Wind direction, visibility, sea conditions, object characteristics will determine "proper" altitude. If visibility poor, rotary wing aircraft may perform the beep to a hover maneuver to descend to a lower altitude.
39. Level off at desired altitude.	Observe radar/barometric altimeters. Adjust controls.	--
40. Establish cruise configuration for search. Trim aircraft.	Adjust attitude, airspeed, altitude. Use ICS to position observers for search. Instruct crew on how to accomplish search (how to report sightings, when to drop markers, etc.).	HC130B may feather the two outboard engines to prolong endurance in search.
41. Evaluate on-scene weather condition for ability to comply with search requirements. - Advise RCC of reduced POD, modification of plan or inability to comply.	Visual assessment. May require use of communications radios.	Extremes of sea state, wind of variable velocity, direction, clouds, sun line, etc., will affect ability to perform search tasks. Primarily visual task. If mission cannot be completed, aircraft may return to station, be assigned some other operation or may await weather improvement.
42. Turn aircraft to initial search leg heading.	Adjust controls to roll out of turn on desired heading. Use instruments.	Wind corrections/adjustments may be necessary.
43. Fly initial search leg.	Correlate aircraft time/distance with length of search legs required.	Maintain visual lookout.
44. Maintain track, heading, altitude, airspeed.	Refer to appropriate flight and navigational instruments/capabilities. Adjust controls to compensate for wind effects. See 34 above.	Track position may be kept through any navigational technique/capability appropriate. See 34 above.
45. Maintain visual lookout for object of search.	Observe left and right of aircraft to limits of sweep width.	Visibility may limit effectiveness of search.
46. Determine end of track reached.	Read manual records (DR plots, position records). Read navigation instruments as appropriate.	--
47. Turn aircraft to new heading to assume new track within search pattern.	Adjust controls to turn smoothly to new heading. Read instruments.	Observe outside aircraft.
48. Accomplish "automatic" search. (HH3F only)	Select search mode and pattern on computer panel. Use keyboard to enter start point and	Observe outside aircraft.

(Continued)

Table 4 (Continued)

Task	Cues/Equipment Involved	Comments/Qualifications
48. Continued.	course. Insert desired leg length. Observe AFCS indicator (Mode C) for progression of pattern. Read "arrive destination" light 45 seconds prior to end of leg length.	
49. Repeat search legs as required.	--	Maintain visual lookout.
50. Maintain electronic lookout as required and appropriate.		
- Utilize search radar.	Operate radar, interpret paintings on scope.	Use is conditioned by reflectivity of object of search. Influenced by sea state, wind direction.
- Utilize direction finding equipment.	Operate direction finding equipment.	Radio range atmospheric and geographic attenuation as they affect given radio frequency bands. These may be directed against distress object, datum marker buoy, other air or surface craft already on scene.
51. Maintain voice communications.	Use all communications radios to communicate with controlling agencies, other aircraft, ships, distress subject, etc. Report on-scene weather.	Radio range attenuation/propagation factors.
52. Perform on-scene commander duties as required. - Direct search efforts of other craft. - Receive search information from other participating craft. - Prepare and transmit consolidated situation reports. - Assign altitudes, search areas to participating craft.	Communications radios. Recall appropriate portions of CG 308 (2) and CG 233 (7).	Coordinate with radioman. OSC not normally assigned to HH52A aviators.
53. Revise/modify search pattern being flown. - Obtain new information concerning subject situation from SMC/RCC. - Revise track spacing, altitude, etc., as necessary to comply with instructions or situational factors. - Continue search.	Communications radio: assessment of on-scene situation.	If OSC, instruct other craft on new requirements.
54. Obtain contact with possible objective.	Visual or electronic sighting.	--
55. Approach sighting for identification.		
- Note aircraft position on search track.	Obtain LORAN reading from radioman; drop smoke or dye marker for position or DR from position.	
- Leave track by turning aircraft in direction of sighting.	Adjust controls to make appropriate turn which provides for continued visual sightings.	Note winds.
- Note time, distance and heading to sighting or fly doppler.	Record position or note mentally. HC130B: Use doppler system.	Wind effects will require appropriate corrections.

(Continued)

Table 4 (Continued)

Task	Cues/Equipment Involved	Comments/Qualifications
55. Continued.		
- Make positive identification of sighting, and	Visual task. May require maneuvers around the object.	Under some circumstances, positive identification may be possible through electronic means (e.g., radar target and DF fix coincide).
- Proceed to provide required assistance, or	See 59 through 69 below.	
- Return to track position with compensation for winds.	Turn aircraft. Return on reciprocal of outbound course to original track position.	
- Resume search.		If visual sighting was lost aviator will execute survivor relocation procedure (CG 308 [2]) to attempt to regain visual contact.
56. Suspend search. - Complete coverage of search area.		
- Determine aircraft/crew no longer able to render assistance.	Assess crew fatigue. Determine fuel level, malfunctions preclude further effort, weather deterioration precludes further effective search.	Experience factor.
- Report leaving scene.	Communications radio.	
57. Return to operating airfield or accept new assignment.	Communications radio.	--
58. Identify mission objective. Prepare to provide assistance.		Location of the subject of the distress may occur as the logical culmination of a fairly long, extensive search, after a short search, or may not have involved search at all. However, and whenever the subject was located, once it is found, the aviator now proceeds to provide whatever assistance is required. Fixed wing aircraft may drop survival/rescue material or assist in other ways. For rotary wing aircraft, rescue/recovery activities are accomplished either from a hover or by landing, often on the water, from the hover.
RESCUE ACTIVITIES		
Fixed Wing Aircraft		
59. Execute aerial delivery. - Establish reference to subject. - Set up pattern over/around subject in accordance with CG 308 (2). - Select drop point. - Instruct crewman on drop procedures. - Command drop. - Receive verbal report on drop progress and impact point.	Adjust aircraft power and controls, make appropriate turns, establish required altitude, heading, airspeed. Receive reports from crewman over ICS.	Heavy reliance on visual cues is required to effectively execute the drop procedure. Point of drop and altitude is conditioned by object and surface conditions, wind direction and velocity, type of object being dropped and mode (i.e., free fall or parachute) of drop. NOTE: Fixed wing aircraft may also drop flares to illuminate area below for other search craft. A set pattern will not necessarily be flown.

(Continued)

Table 4 (Continued)

Tasks	Cues/Equipment Involved	Comments/Qualifications
60. Accomplish aircraft intercept and provide escort services.	Visually, identify other aircraft. Adjust power/controls to fly "formation" on other aircraft. Adjust altitude, airspeed, heading.	Completion of intercept/escort mission requires visual cues to line up on and inspect other aircraft's structure, provide escort. NOTE: Aviator must be prepared to advise aircraft on ditching procedures, illuminate sea lanes if necessary. (See CG 306 [3])
61. Perform orbit manouvers/services.	Ad[illegible] aircraft controls to main[illegible]ain relative position. Execute turns, altitude changes, etc., as required. Utilize navigation and communications equipment as required.	The aircraft may maintain a visual surveillance on an object or function as a "high" altitude radio relay/navigation platform for other craft.
62. Perform off-shore water landing (HU16E only).	Perform in accordance with CG 372 (8) and CG 333 (1).	Perform only in extreme urgency and with appropriate authorization. Requires extensive use of vision to assess winds, sea conditions, and to determine proper landing procedures.
RESCUE ACTIVITIES		
Rotary Wing Aircraft		NOTE: Hover is the basic "manouver" for RW rescue activities.
63. Fly aircraft to hover.		
a. Perform beep procedure on instruments to establish hover. - If visual contact to surface obtained at 0 airspeed, proceed to accomplish water landing or hoist. - If visual contact not obtained descend slowly to obtain visual contact, then proceed with landing or hoist. - If visual contact not obtained by 30' on radar altimeter, perform instrument takeoff (see 22c above).	Control altitude, airspeed relationships, control nose attitude with beeper trim switch. Observe visually and cross check radar altimeter. Perform in accordance with respective standardized procedures.	Note different airspeed and time relationships for HH3F than for HH52A. Perform under marginal visibility conditions or at night. Copilot serves as "visual" safety pilot.
b. Perform normal into-the-wind approach to hover.	Adjust controls to position helicopter.	Perform under acceptable visibility.
c. Accomplish automatic hover (HH3F only).	Engage couplers--perform in accordance with procedures of flight manual. Read ACFS indicators for drift.	
64. Perform water landing from hover. - Evaluate sea condition visually to determine feasibility of landing. - Perform before-landing checklist. - Control aircraft to settle smoothly on water with level or slightly tail-low attitude.	--	Requires visual contact with water's surface. Difficult task at night because of limitations on depth perception.
65. Perform water taxi.	Use cyclic, tail rotor pedals for directional control in turns. Use power as required by sea conditions. Maintain speed below 15 knots.	All water operations require cautions against ingestion of salt water into engine(s).

(Con[illegible]ued)

Table 4 (Continued)

Task	Cues/Equipment Involved	Comments/Qualifications
66. Perform platform rescue as required.	Accept crewman's instructions over ICS for maneuvering aircraft to pick up point.	Requires visual cues.
67. Perform water take-off. - Perform normal take-off to high hover. - Perform instrument take-off.	 Adjust power/controls. See 22a above.	Sea state, wind effects, possible ingestion affect take-off. Observe tail rotor clearance acceptable. Perform when visual references not adequate (e.g., salt spray).
68. Maintain hover for hoist operations. - Control aircraft position steady over variety of objects. - Use external visual reference to control aircraft position. - Use crewman's instructions to control aircraft position. - Enable automatic control of hover as appropriate (HH3F only).	 Maintain reference to objects below. Respond to conning instructions from hoist operator on ICS with appropriate control inputs. Engage couplers-use AFCS indicator to read drift. Listen on	In hover, aircraft may retrieve objects of individuals or may lower objects to surface craft. Movement characteristics of helicopter, water and vessel combine to affect difficulty of task. Frequently requires pilot to fly formation on vessels. When hoist complete and individual secured, establish climb and leave area. Receive crewman's reports of action being taken of hover trim stick engaged.
69. Accomplish confined area landing.	Monitor obstructions visually, while descending. If landing on vessel, control aircraft to null out relative motion and descend vertically.	Observe and control for movement characteristics of vessel on which landing. Control helicopter in accordance with LSO hand signals as appropriate. All confined area operations require use of vision to observe hazards, align helicopter with landing point.
70. Accomplish confined area take-off (perform maximum performance take-off).	See 22 above.	Monitoring visually for obstructions required.
71. Establish climb.	Adjust power/controls to establish desired climb rate.	--
72. Level off at cruise altitude.	See 30 above.	--
73.[a] Establish return cruise configuration.	See 31 above.	--
74. Perform enroute navigation on return flight.	See 34 above.	--
75. Perpare/modify flight plan.	Use aeronautical charts. Compute arrival times, etc.	--
76. Transmit flight plan as appropriate.	Transmit on communications radio to ATC or operations.	Radio range attenuation factors. Coordinate with radioman.
77. Monitor aircraft/system status.	Monitor all instruments, advisory lights, circuit breakers and aircraft structure.	--
78. Perform approach navigation.	Tune radios, identify facilities. Use instruments for position information. Control aircraft appropriately. See 34 above.	

[a]*Tasks listed from this point apply to all aircraft.*

(Continued)

Table 4 (Continued)

Tasks	Cues/Equipment Involved	Comments/Qualifications
78. Continued.		
- Perform VOR approach to minimums.	VOR indicator, approach plates. Use flight director group for heading, steering data (HH3F, HC130B). Descend as appropriate.	Correct courses for wind effects for all track following.
- Perform ADF approach to minimums.	Read instruments, refer to navigational publications. Descend as appropriate.	
- Perform TACAN approach to minimums.	Read instruments. Refer to publications. Use flight director group for heading, steering data (HH3F, HC130B). Descend as appropriate.	TACAN not standard in all HH52As.
79. Proceed to airfield visually.	Observe outside aircraft for position/direction information, other aircraft.	--
80. Perform precision approach to airfield.		Instrument approach tasks are discussed more fully in the text below.
- Accomplish ILS approach to minimums (front or back course).	Use course indicator or flight director group. Make appropriate course corrections.	
- Accomplish GCA approach to minimums.	Respond quickly and appropriately to controller's instructions over communications radio.	
81. Perform pre-descent, descent procedures.	Perform in accordance with flight manual.	--
82. Perform missed-approach procedures.	Execute in accordance with published instructions and flight manual.	--
83. Execute landing.	Proceed visually to complete landing.	Correct for wind effects from any direction, variable velocity.
84. Taxi aircraft to parking area.	See 20 above.	--
85. Complete after-landing checklist and secure aircraft.	Perform in accordance with procedures outlined in flight manual.	--
86. Accomplish required reporting.	Notify RCC of arrival, complete aircraft summary report.	Coordinate with operations.

that are involved in the performance of a given task are identified in the second column. Important conditions influencing the performance of the task and other comments as appropriate are presented on the right. In essence, the task items represent training that would be considered as appropriate for training an individual aviator to the Aircraft Commander level of skill in a SAR aircraft. Development of specific training programs for skill progression (i.e., CP to FP, FP to AC) will require partitioning the task requirements in some logical manner (e.g., manipulating overall performance tolerances) consistent with the skill and knowledge requirements (1) for a given designation.

TRAINING REQUIREMENTS CATEGORIES

In addition to the purposes previously noted of the task listing above, the inventory was also used as a basis for collapsing the essential tasks required in SAR operations into related categories for further exposition. These categories are presented below. Specific training objectives included in each category are discussed as are their implications for transition, qualification, or proficiency training programs and for presentation in academic, synthetic, or flight training programs. Instrument approach/navigation tasks have been considered as representing advanced instrument maneuvers for the aircraft rather than being identified as a category apart from aircraft control.

Aircraft Control

Each aviator must learn the basic power/control relationships unique for the given aircraft in which he is receiving training. He must acquire the necessary skills to control the aircraft safely through all its operating regimes. This means, essentially, that he must learn differentially to apply power and control inputs (including amount and direction of control displacement and sequential and temporal patterning of inputs) responding to either intra- or extra-cockpit visual cues to establish, maintain, or change specified steady states (or conditions) for the aircraft. The specific controls that are used and the patterning of inputs required for these purposes are, of course, a peculiar function of the particular aircraft involved and training will be required to learn these relationships for each specific aircraft.

Specific ways of achieving aircraft control training objectives must be addressed within the context of development of a total program of instruction for a given aircraft and for a given purpose, i.e., for transition or qualification training for initially learning to control the aircraft safely or for proficiency training emphasizing maintenance of a standard level of aircraft control. Aircraft control tasks will be prominently involved in all programs of instruction concerning a particular aircraft. For convenience, aircraft control tasks are further discussed in terms of performance of basic or advanced maneuvers for the aircraft. Degraded control operations are considered under emergency procedures below.

Basic Maneuvers. For each aircraft certain "basic" maneuvers must be learned which the aviator must be able to perform using external

visual (i.e., contact) cues or using information available from the cockpit instruments for control of attitude and position of the aircraft. Those tasks requiring heavy reliance on contact cues for effective performance (e.g., take-offs, landings, circling approaches) cannot adequately be trained in a simulator lacking an effective visual simulation of the external visual environment. Portions of these tasks (i.e., integrated responses which can be later transferred to contact cues) will be learned, however, by practice gained while flying the maneuvers under simulated instrument conditions in a simulator.

The basic principles involved in controlling the attitude of an aircraft on instruments should be well understood by the aviator by virtue of his prior training. He will be familiar with the meaning and interpretation of information presented on his attitude indicator (sight pictures) and with alternate in-cockpit sources of this information should the attitude indicator presentations become unreliable. While the absolute amount of training required should be small because of prior training, some time must be devoted to aviator practice for learning the relationships between control input sequences and instrument readings for a specific aircraft.

For the particular aircraft, the aviator must learn the appropriate sequence and pattern of power and control inputs required to taxi the aircraft and for executing take-offs from a variety of runway surfaces (rough, smooth, wet, slippery) at a variety of elevations. He must also learn proper procedures for executing take-offs under varying conditions of gross weight and safe locations of the center of gravity of the aircraft with winds from variable directions and of variable velocities. The HU16E student aviator and those training for rotary wing aircraft must also learn appropriate control techniques for taxiing the aircraft on water and for making take-offs from the water. Each aviator, when performing his own control tasks, must also learn to coordinate his control inputs appropriately with his copilot and, in the HC130B, with the flight engineer. In addition to performing running take-offs, rotary wing trainees must learn to accomplish normal take-offs from a hover and maximum performance take-offs featuring near vertical ascents for operating from ships or other confined areas. Control procedures for landing the aircraft under essentially similar conditions must also be acquired by the aviator.

Mastery of basic maneuvers for the aircraft means that the aviator will emerge from the training program capable of controlling the aircraft:

In <u>straight and level flight</u> maintaining level pitch and roll attitudes with altitude, heading, and airspeed within acceptable limits and employing correct power settings.

To <u>perform level turns</u> in which he correctly establishes and maintains within limits the prescribed rate of turn, rolls in and out of the turn smoothly, maintains his altitude and airspeed within acceptable limits and is capable of rolling out on a desired heading within a specified number of degrees.

To perform <u>accelerations and decelerations</u> by smoothly changing power to obtain the required change. He will also maintain the primary flight parameters (heading, altitude, and airspeed) within acceptable limits.

In <u>straight climbs and descents</u> by initiating the maneuver smoothly through appropriate power increase/reduction while coordinating pedal trim with the power change to maintain his assigned heading within limits and to level off smoothly within a defined value of his assigned

altitude. Throughout the maneuver he will maintain his assigned airspeed, heading and rate of climb or descent within acceptable limits.

To perform timed turns in which he establishes the roll-in smoothly, establishes the turn, maintains the turn, maintains within limits his assigned altitude and airspeed, establishes his roll-out smoothly and rolls out within an acceptable margin on the desired heading at the specified time.

To perform steep turns establishing the roll-in smoothly and establishing the assigned rate of turn. He should be able to maintain his airspeed within limits and his rate of turn. He will maintain his assigned altitude and airspeed within acceptable limits and establish the roll-out smoothly as required.

In climbing and descending turns, the aviator must learn to coordinate his roll-in and the beginning of the climb or descent smoothly. He will maintain the prescribed rate of turn, maintain his rate of climb or descent within allowable limits, coordinate the roll-out and level off smoothly. He will roll out on his assigned heading within an allowable margin of heading error and at approximately the specified time, level off within specified limits of his assigned altitude and appropriately maintain his airspeed.

In addition to the performance of the above basic maneuvers for his aircraft, each aviator must also learn control procedures to correct for unusual attitudes. He must be able to correct roll attitude with minimum change of heading and pitch attitude with minimum change of altitude. He will adjust power appropriately.

All of the basic maneuvers must be performed under conditions of either good or poor visibility, with winds of variable intensity from any direction, in turbulence or in rough air and under extremes of temperature.

The aviator transitioning to a rotary wing aircraft must also learn control procedures for safely executing an autorotative descent in the event of engine failure(s) or occurrence of other conditions which may require its performance. Thus, he must learn to appropriately maintain heading, airspeed, and rotor speed within limits, initiate his flare at the correct time (altitude), level off, eliminate drift and maintain a level attitude until touchdown.

Training for the performance of basic maneuvers for the aircraft must, of course, be included in all transition and qualification training programs. To insure retention of basic control skills, they should also be included in proficiency programs devised to assess/maintain basic aircraft control skills. While all basic maneuvers may be taught in the aircraft, those involving the use of instrument cues can be taught perhaps equally as well in a synthetic device where student errors can be assessed and corrected without penalty to the aircraft and where a wide range of weather conditions can be established at will. Those basic maneuvers relying extensively on contact cues for initiation and continuation must be taught in the aircraft since visual simulation devices for attachment to flight simulators which could present satisfactorily the necessary contract cues are not currently available. However, the pattern of responses required can be taught in a synthetic device.

Advanced Maneuvers. Having mastered the fundamentals of control of the aircraft in regard to the performance of basic maneuvers, the aviator must acquire control skills for performing advanced maneuvers for the

aircraft. To perform advanced maneuvers, the basic maneuvers are patterned together in various ways for the achievement of given aircraft states. Certain additional requirements (e.g., communications tasks, navigation tasks) may also be brought in. Advanced maneuvers include all instrument navigation/approach flying tasks for the aircraft. They also include accomplishment of SAR tasks. Training for the execution of advanced maneuvers can be incorporated within later phases of transition or qualification training programs or they may be considered as constituting a separately identifiable training program which could provide a basis for the aviator's acquiring control skill necessary for advanced designations in type of aircraft.

Instrument Maneuvers. All instrument navigation/approach tasks are considered here to represent advanced maneuvers for the aircraft. They include:

GCA. The aviator must be able to perform competently all required tasks for executing a ground controlled approach (GCA) to the airfield. He must correctly perform a number of specific steps that are involved in this particular approach.

a. He must correctly perform the radio contact procedure by selecting (from appropriate publications, or by instruction) the correct agency to contact to request the GCA, tune the radio correctly, and make the correct initial contact.

b. He must follow heading instructions given him by the controller, initiate turns immediately, repeat the headings as required and maintain the heading(s) within defined limits.

c. He must follow altitude instructions given by the GCA controller which requires that he check and set his altimeter, start climbs or descents immediately, follow the controller's instructions, repeat altitude or rate of descent as required and maintain the specified altitude within limits.

In the course of performing the GCA, the aviator must turn timely and accurately (start turns immediately, execute the turns at the prescribed rate and roll out on the required heading) and use correct voice procedures. He must copy the controller's instructions for missed approach, determine action in the event of a missed approach and, if appropriate, tune his navigational radios in anticipation of a missed approach. The aviator must control his aircraft to stay above altitude minimums. If visual contact is obtained, he lands visually. If it is not obtained before the controller terminates the approach, he executes a missed approach in accordance with previous instructions.

ADF Navigation Approach. Execution of an ADF approach, or use of ADF for navigational purposes requires that the aviator perform a number of control tasks plus certain other tasks to appropriately move the aircraft to a planned destination. The tasks are highly similar to those involved in locating a vessel at sea or in flying an intercept mission.

The performance requirements for executing an ADF approach consist of the following activities:

a. Tune Radio. The aviator must correctly tune and identify a non-directional beacon, maintain radio volume at a comfortable level, use the correct voice procedure and phraseology, and use appropriate publications to locate facilities.

b. Orientation. The aviator must tune and identify the appropriate non-directional beacon, use the appropriate instruments to determine his course to the station, and make level turns within tolerances.

c. Track Interception. The aviator must identify interception of the track, tune his receiver to a new station correctly, roll out of turn on course to the new station, and make level turns within tolerances.

d. Track Following. The aviator must maintain level roll attitude, maintain assigned altitude within limits, maintain the assigned airspeed, and assigned course.

e. Radio Fix Identification. The aviator must correctly interpret reversal of the needle, note time of station passage, start his turn to desired heading (if applicable), and maintain course to the new station (if applicable).

f. Holding Pattern Entry. The aviator must make a correct entry into holding pattern, make level turns within tolerances, and roll out on the correct inbound course or outbound heading.

g. Holding. The aviator must roll out on the correct inbound course, hold the inbound leg for one minute, maintain his assigned altitude within limits, make level turns within tolerances, and maintain the assigned airspeed.

h. Approach Procedure. The aviator must request the approach correctly, intercept the outbound course, control the aircraft so as not to exceed the altitude minimum, make a procedure turn within tolerances, report the final fix inbound (or completed procedure turn), make a straight descent within tolerances, maintain the recommended approach speed and report reaching minimums.

i. Missed Approach (Preparation). The aviator must locate the missed approach procedure for the airfield on the appropriate publication, determine action to take in the event of a missed approach, and when practicable, tune his radios in anticipation of a missed approach.

j. Termination of Approach. In terminating the approach, the aviator will not proceed below the specified altitude. If visual contact is not obtained by the proper time after final fix passage, he will execute a missed approach. If visual contact is obtained, he will land visually.

k. Reporting Procedures. In controlling the aircraft for the ADF approach, the aviator will also give position reports at proper time, include the necessary items in the position report, report items correctly, report changing altitude, include the proper items in the change report, report holding, and include the proper items in the holding report. He will also report leaving the holding pattern and include the proper items in the departure report.

VOR/TACAN Navigation/Approach. With the exception of the instruments and equipment used for extracting required information for making control decisions, the performance requirements of VOR and TACAN approaches are essentially the same as the ADF approach; hence, they will not be repeated here.

ILS Approach. Aviator control requirements for performing an ILS approach are similar to those involved in VORTAC approaches to airfield minimums. Additional requirements making for more precise control of the aircraft relate to identification of the localizer beam interception and correct roll-out onto the centerline. Control of the aircraft's velocity, altitude, and rate of descent on/along the glide slope is required.

In addition to performing the advanced instrument maneuvers using conventional navigational instruments, aviators transitioning to the HH3F or HC130B aircraft must also learn correctly to use the respective flight directors installed in these aircraft. They must correctly interpret the displayed information and appropriately execute commands indicated by the displays. The HH3F student aviator must also learn effectively to use the navigational computer (program inputs, read displayed information) for accomplishing necessary control operations based on the displayed navigational information. The HC130B aviator must also learn correctly to control the aircraft from displayed doppler information.

Beep to a Hover Approach. An additional advanced instrument maneuver for rotary wing aircraft student aviators is learning the control and timing operations required to successfully perform the Beep to a Hover maneuver. At night or under other conditions of limited visibility, this procedure is used to position the helicopter for a possible landing or hoist. It involves complex timing and coordination requirements. The performance requirements for executing the beep pattern are listed below.[1]

a. Turn and adjust pattern to pass datum on a downwind heading at 300 feet.

b. Hold heading for required time.

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[1]The HH52A Standardization Manual (5) contains complete requirements for that aircraft. A forthcoming revision to the HH3F Flight Manual (4) will detail the performance requirements for the HH3F aircraft.

c. Execute required turn(s).

d. Initiate recovery to wings level attitude.

e. Roll out on desired heading.

f. Restart clock and start immediate descent to 140 feet altitude (150' for HH3F). Control descent rate (not more than 400 fpm).

g. Level off and stabilize heading, altitude, and airspeed.

h. Arrive at gate. Commence beep to a hover.

i. Decrease torque and beep nose to proper nose-up position (10° for HH3F, 6° for HH52A) to start gradual deceleration and descent of 100 - 150 fpm.

j. As speed decreases monitor and maintain nose position and wings level attitude.

k. Make control inputs only with Beeper Trim button using short beeps and very small collective (torque) changes. Heading control is left with ASE heading retention feature (HH52A) or AFCS heading retention feature (HH3F).

l. Monitor check points (both pilots)

HH3F		HH52A	
Altitude	Airspeed (KIAS)	Altitude	Airspeed (KIAS)
150	70	140	55
125	55	100	40
100	40	70	30
75	25	40	0
50	0		

m. Approaching 50 (40) feet, increase collective to check rate of descent and attain hovering power. If proper procedures have been followed (e.g., correct nose-up position maintained, wings level attitude, airspeed within limits), the helicopter will transition to an approximate hover without further pilot effort.

n. Use Beeper Trim as required to attain correct nose attitude for hovering.

o. Attempt to obtain visual contact with surface and/or descend aircraft to lower altitude.

p. Land visually, establish hoist position visually, or accomplish ITO.

Pilots transitioning to Coast Guard aircraft will generally be familiar with the performance requirements of the advanced maneuvers described above (with the exception of the beep-to-a-hover procedure) and will already hold instrument ratings. Performance of such maneuvers should be included in transition training programs, however, to provide pilots experience with the instrument presentations of the new aircraft and to enhance required aircraft control skills. For similar reasons such training must be included in qualification courses, especially rotary wing qualification courses where the student aviator may also be required to train for his initial instrument qualification for that category of aircraft. Training for the use of "new" instruments (e.g., doppler in HC130B, navigation computer in HH3F, flight directors in HH3F and HC130B) must, of course, be included in training. Academic training for the use of the new instruments is desirable followed by practice in the aircraft or in a synthetic device. Practice flying for performance of the instrument tasks can be given perhaps as well in a simulator (and more safely) than in the aircraft although some training should still be given in the aircraft to insure (check) the validity of the synthetic training.

Contact Maneuvers. A number of advanced maneuvers for each aircraft must be performed in which the pilot relies heavily on extra-cockpit visual information (contact cues) for initiating or continuing control inputs. Only limited training can be given for such task performance in a synthetic device lacking an effective visual display system. Tasks relying extensively on visual cues for performance include normal take-offs and landings (water or land) where extra cockpit visual cues are prominently involved in the pilot's assessment of and responses to a rapidly changing external visual environment, observation of hazards in the take-off area and maintenance of position on the runway or in taxi areas.

Similarly, take-offs and landings by helicopters from ships or other confined areas where careful attention to rotor clearances around hazards and visually matching speed and movement of the helicopter with that of the ship is required cannot adequately be trained for in a synthetic device not having an external visual attachment which simulates on an unprogrammed basis the complex of rapidly changing visual cues of the real world. For the same reasons hovering operations by helicopters cannot be adequately trained in a synthetic device because of the necessity for the pilot to visually maintain his position relative to the object over which he is hovering and to make control responses in the helicopter corresponding to the changed perspective of the vessel, man in the water, raft, or other object on the water.

Because of the importances of visual cues in estimating wind direction, tail rotor clearances, aligning the aircraft with respect to the water's motion, etc., water operations for the two helicopters and for the HU16E aircraft should be trained in the particular aircraft itself.

Pilotage (navigation by reference to external visual features) could also be included in this category. For the fixed wing aviator, the most important tasks that he must perform are those concerned with accomplishing actual "rescue" operations. The fixed wing aviator must learn to control his aircraft in the operational setting in such a way that he,

or another crewmember, can maintain a constant visual reference to the subject of distress or to some other external visual referent (e.g., smoke markers). He must also learn to accomplish drop procedures requiring visual references and receive feedback on the effectiveness of the drop, fly "formation" on an intercepted aircraft, perform survivor relocation procedures, etc.

In actuality, the entire search and rescue mission cannot be performed without the availability of visual cues with the possible exception of missions or portions of missions that can be accomplished electronically (e.g., radar, DF). This does not mean, however, that training to perform these tasks cannot be given in a synthetic device. What it does mean is that only partial training can be given due to the lack of visual cues and that further training will be required in the aircraft. For example, the timing and patterning of responses required to perform specific search or rescue operations (e.g., execute a drop pattern, fly the survivor relocation pattern) can be learned in a synthetic device and practice making these responses to a specific visual target can subsequently be given in the aircraft.

For simple transition and qualification training purposes, advanced SAR maneuvers need not be included in the program of instruction. Proficiency training programs should include all advanced maneuvers. Best use of a simulator for these tasks appears to be for the learning of complex control sequences. Complete training for the performance of these tasks, however, must be given in the aircraft.

Procedural Tasks

A major portion of the job of an aviator transitioning from one aircraft to another is the learning of the procedural tasks[1] associated with the operation of the aircraft under normal or emergency conditions.

Normal Procedures. Each transition and qualification student must be trained to perform proficiently all normal procedures for the particular aircraft involved. For any aircraft, the transitioning aviator must become proficient in performing the checklist items to the criteria established by the respective flight manuals for the following procedures:

- Prestart.
- Engine start and runup procedures (including rotor engagement in rotary wing aircraft).
- After start including appropriate taxi procedures.
- Take-off.
- After take-off.

[1]The definition used here of procedural tasks refers to separate sets of tasks performed usually in a sequence and which frequently involve use of a checklist and are performed as secondary to the primary task of aircraft control. "Procedures" which are an integral part of a control task (e.g., the sequence of operations required to perform a Beep-to-a-Hover approach) are not treated independently of the overall maneuver for which they are performed.

. Level off.
. Pre-descent.
. Descent.
. Landing.
. Post-landing.

Required knowledge concerning location and function of cockpit items can be obtained from practice in performing the procedural items in a synthetic device or in various other ways.

Emergency Procedures. All aviators, regardless of type of aircraft involved, require training in emergency procedures for that aircraft. Practice will provide opportunity for the pilot to recognize unsafe, or potentially unsafe conditions, and to learn to take effective action so as to continue flight or execute a safe landing.

A compilation of emergency procedures for each one of the four aircraft was made from the flight manuals. The listing identifies, by aircraft, the specific symptoms of given failures and the corrective action sequences required to minimize or "correct" for failure effects. It was prepared for subsequent use in developing training materials for specific transition, qualification, and proficiency training programs and for specification of design features for synthetic equipment intended to provide emergency procedures training. It has not been included here because of the ready availability of such information in the Flight Manuals. In this section, emergency operation considerations are presented in very abridged form for each aircraft.

Overall, the objectives for emergency procedures training concern the subject's learning correctly to recognize unsafe conditions and to make the most effective responses possible to those conditions when they do occur in the actual aircraft. The student pilot must learn for the aircraft indicated to recognize the abnormal conditions indicated and to perform the appropriate corrective action sequences. The introduction in the actual aircraft of any emergency condition poses a safety problem for the aircraft since it degrades aircraft performance. Certain emergencies, however, cannot be practiced in the aircraft under any circumstances. These are indicated in the listings by an asterisk. Those that can be practiced in either a simulator or in the aircraft with appropriate precautions are not annotated.

HH3F

Engine Emergencies

- APU inoperative - external power starts.
- Starting with emergency fuel control lever.
- Engine malfunctions.
- Engine failure (both).
- Single engine failures and single engine operations (must also be practiced in aircraft).

Gear box failures.*
Tail rotor system failures.*
Fuel supply system failures.
Electrical power supply system malfunctions.

Utility hydraulic system failures.
Flight control hydraulic system failures.
Automatic flight control system failures.
APU fire.*
Engine fires.*
Electrical fires* (cannot be simulated).
Landing gear emergencies.

HH52A

Engine Emergencies (ground).
Engine Emergencies (inflight).

- Complete power loss.
- Partial power loss.
- Engine restart.
- Engine overspeed.

Rotor system overspeed.*
Tail rotor control system failures.*
ASE failures.
Rotor blade damage.*
Engine fire.*
Electrical fire (cannot be simulated).
Main gear box oil system failure.*
Electrical power supply system malfunction.
Fuel system failure resulting in engine failure.*

HU16E

Engine Emergencies.

- Engine failure on take-off.
- Single engine operations.
- Engine restart in flight.
- Aborted take-offs (dangerous to practice in aircraft).

Fuel system failures and emergency operation.
Propeller failures.

- Feathering/unfeathering.
- Propeller overspeed.
- Runaway propeller.
- Low oil supply.

Engine fire(s).*
Fusolage and wing fires (cannot be simulated).
Landing emergencies

- Crash landing procedures[1]

[1]Partial training could be given in simulator.

- Open sea landings (aircraft only).
- Water taxiing (aircraft only).
- Electrical power system failures.
- Hydraulic system emergencies.
  - Hydraulic pressure loss.
  - Emergency flaps procedure.
  - Landing gear emergencies.
  - Brake system emergencies.

<u>HC130B</u>

- Engine emergencies.
- Engine failures.
  - Shutdown procedures.
  - Engine restart.
  - One or two engine out operations.
    - Two engines out on one side.*
  - Three engine take-off.
  - Engine overheat.
- Engine systems failures.
- Propeller failures.
- Fuel system failures.
- Engine fires.*
- Fuselage and wing fires (cannot be simulated).
- Electrical fires (cannot be simulated).
- Gas turbine compressor fires.*
- Pressurization emergencies requiring pilot action (e.g., rapid decompression).
- Overheat conditions.*
- Take-off and landing emergencies.
  - Take-off short (dangerous to practice in aircraft).
  - Take-off continued after engine failure.
  - Various landing gear failures.
  - Nose wheel steering failure.
- Fuel dumping procedures.
- Electrical systems failures.
- Hydraulic systems failures.
- Flight control system failures.
- Flap system failure.
- Landing gear system failure.

The evidence is logically clear that a simulator is superior to an aircraft for providing opportunity to practice a wide variety of emergency procedures under a wide range of conditions. A safe environment with opportunity for repeated practice under realistic conditions (e.g., motion cues, sounds and effects on other systems) can be provided. There is also considerable evidence that procedures learned (both normal and emergency) in a simulator transfer virtually intact to the aircraft. Thus, to economize aircraft time and for safety considerations, all

procedural tasks should be trained in a simulator (or other appropriately designed synthetic device). Knowledge concerning location and function of cockpit components should be acquired in the synthetic device largely as a by-product of procedures performance practice. Academic training to support understanding of causes of various failures, back up systems available for given types of failures and important system interconnections will also be required.

Training in emergency procedures for the aircraft should be given in all training programs. Special emphasis should be placed on the retention of emergency procedures. Since their performance will not normally be required in the aircraft, consideration should be given to the development of special training programs for accomplishment of refresher training.

Mission Planning Tasks

To prepare for the execution of any particular mission, the aviator must perform a variety of predominantly mental activities to process information for devising a plan of action for conducting a particular mission. Planning for the mission requires the aviator to draw appropriately from at least three background sources of information. Formal academic programs of instruction are required to impart these background knowledges. Information required relates to knowledge of the aircraft, knowledge of inflight navigation, and general SAR knowledge.

Aircraft Knowledge. The aviator should acquire a basic knowledge of the aircraft in a formal academic program of instruction. This should include a general description of the aircraft, its performance and handling characteristics for various conditions of weight and balance; capabilities for all weather operations; water operations; location of components; types of on-board equipment and operating characteristics; limitations/capabilities; knowledge of the various aircraft systems (e.g., fuel, engines, electrical, hydraulic, mechanical) and important interrelationships (e.g., engine and electrical system), etc.

Navigation. To perform navigational planning tasks effectively, the aviator must possess a broad array of background information. This includes basic principles involved in inflight navigation, ability to read and interpret the various navigational publications, aeronautical charts; how to plan optimum courses for navigation to given locations including selection of enroute navigation facilities, computation of times and distances along legs, etc.

Generally speaking, all aviators entering a Coast Guard training program will already be well-versed in basic navigational techniques and principles and will have accomplished navigational planning for other aircraft at some prior time in their flying experiences. Thus, training emphasis should be on interpretation and meaning of information

displayed and on any *new* items of instrumentation (e.g., flight director in HC130B, HH3F, and navigational computer usage in HH3F, etc.) with which the trainee may be unfamiliar and on adapting the previously acquired information/expertise to the new aircraft. Practice actually flying the "aircraft" on instruments can be given in either the aircraft or a synthetic training device.

For fixed wing aviators qualifying for the first time in rotary wing aircraft, a certain amount of academic instruction concerning differences in instrument presentations for RW and FW may also be desirable.

SAR Planning. Aviators newly entering the Coast Guard will have little previous familiarization with the techniques and principles of planning for the conduct of a specific search operation. While the principal objective of transition and qualification training programs is to learn the capabilities of the aircraft with respect to control of the aircraft for specific purposes, it is suggested that the programs be expanded to include academic training on search planning. This would not only promote an understanding of the roles of other Coast Guard agencies and individuals in SAR, but it would also develop in the aviator a better appreciation for the capabilities of his aircraft for performing in the operational context.

Communications Tasks

Coast Guard aviators perform a variety of communications tasks for specific purposes within the context of operational missions. The simple motor skills required to operate communications equipment (i.e., turn on radios, tune to given frequencies, select functions, adjust volume) will already be well established within the aviator's repertoire prior to his entering a specific Coast Guard conducted flying training program. To supplement aviators' existing knowledges, a brief familiarization with the characteristics (susceptibility to electromagnetic interferences, reliability) of on-board communications radios (including the ICS) and a description of operating ranges should be given. This should include consideration for geographical or atmospheric attenuation factors (if unique) plus an appreciation for any unusual features of the equipment (e.g., lack of effective VHF communications in the HH52A when the VOR navigation function is being used). The location of the radios within the cockpit and at the radioman's position should also be pointed out. Thereafter, the aviator should be provided opportunity to utilize the communications equipment within the context of some larger flying (or simulated flying) task to further develop his own verbal communications skills and to learn better to time-share the necessary communications tasks with other tasks such as aircraft control, navigation, etc. Such training should feature use of the communications equipment for simple information transmission or information reception and for tasks where the aviator must control his own aircraft on the basis of verbal inputs and/or control (to some degree) other craft mutually involved in a specific operation. Such communications tasks include:

Requesting, and responding to, ATC, OTC, or ICAO instructions.

Crew coordination and instruction including learning to accept the crewman's verbal instructions in RW aircraft for trimming the aircraft's position for rescue operations.

Issuing position/status reports to operations.

Responding with control inputs to GCA controller instructions or radar control vectors.

Establishing and working through radio relays which may require use of two or more radios.

Controlling the actions of other craft (e.g., as an OSC or for FW aircraft when on an intercept mission).

Using communications equipment for direction finding purposes.

Communicating with other craft in a distress area, including the subject of the case, for coordination of effort purposes.

In addition to training for active utilization of the equipment, the aviator will also require training in the preparation of situation reports (SITREPs) (format and content) with practice provided; in communications discipline and communications procedures as detailed in CG 233 (9) and other relevant publications.

The accomplishment of communications tasks not involving the use of radios should also be recognized as a part of the aviator's overall job. Briefly, these involve the use of hand signals for relaying/receiving information from the copilot, other crewmembers, ground crew personnel, the LSO in the case of RW aircraft effecting a shipboard landing/take-off, recognition of distress symbols and signs (see 2, CG 308) and items such as overflying a vessel with wings rocking to direct the vessel to a distress site. Such items should be included in appropriate training programs as items on which some instruction is required.

Since communications are prominently involved as an integral part of all flying activities, the student aviator should receive training in all instructional programs to maintain proficiency. Emphasizing these items in a synthetic device where verbal communications can be recorded for replay and error elimination is appropriate. This will minimize the need for devoting in-the-air training time to such items.

Management/Decision Making

This category of objectives involves those cognitive processes of a pilot which ultimately determine the success or failure of specific missions. How well he manages the resources available to him and how effectively and timely he makes critical decisions are important to mission success, safety of the aircraft and ability to complete assigned activities. Normally such competency accrues to the pilot as a function of experience over time. However, there are a number of management-related skills for which training can effectively be given and which should receive special consideration in portions of any academic, synthetic, or flight training programs. Wherever possible, syllabus material should be developed to emphasize the requirement for such activities. These range from relatively low order management skills exercised on a more or less routine basis to relatively complex higher order decision making as a basis for some particular pilot action or maneuver. Tasks to be trained in this category relate to:

. Inflight management of aircraft systems (e.g., monitoring instruments and other displays for proper indications of systems functioning, regulating fuel flow and usage, properly using power).

. Proper utilization of copilot (e.g., to contend with an engine fire while the aircraft commander continues to fly the aircraft); during search, for example, when the aircraft commander must time-share performance of several tasks simultaneously, etc.

. Selecting flares (or other devices) of appropriate intensity and persistence for use in a night search operation.

. Assessing a wide variety of sea state and weather conditions, crew factors, and degraded equipment operations for implications for:

- Continuing or terminating specific search activities.
- Exercising options on selection of items such as direction/point/altitude of air drops; water landing versus hoist rescue for rotary wing aircraft, etc.

. Deciding priority of emergency for contending with simultaneously occurring malfunctions/emergency conditions for the aircraft.

. Assigning and properly rotating observers among search positions.

. Performing OSC duties.

. Maintaining crew motivation.

. Crew coordination.

Aircraft Security Check

Included in this category of training objectives are those tasks which are performed to determine the airworthiness of the aircraft prior to the initiation of a given flight. Tasks performed inflight by various members of the crew to insure the continued safety and security of the aircraft are also included. As a group these tasks are performed for the overall purpose of recognizing unsafe or potentially unsafe conditions for the airframe.

Each transition and qualification student, regardless of aircraft type, must learn to perform these tasks thoroughly and competently for that particular aircraft. The airframe is required for the conduct of the required checks. Consequently, "training" for the performance of these checks/inspections must come within the context of a flying training program in which brief explanations are provided as to the nature and general purpose of the inspections and supervised practice is permitted.

Specific tasks are concerned with conducting exterior and interior checks of the aircraft in accordance with the respective flight manuals and assuring proper storage of all equipment items. Periodic checks of the aircraft structure while in flight (e.g., fumes, smoke) are also required.

DISCUSSION

Academic Training

Because of the prior aviation experience of Coast Guard aviators, academic training for development of understanding of navigational techniques and principles, interpretation and meaning of information displayed on given instruments, etc., will only be required for those aircraft where unfamiliar instruments are involved (e.g., flight directors, navigational computers). This can be included as part of an overall academic program for the particular aircraft.

For each aircraft, academic training will be required by transitioning and qualifying students relative to a description of the aircraft, its performance capabilities, limitations, important systems and characteristics (normal and non-normal functioning) and important system interrelationships. Formal training should also be provided RW qualification students concerning the aerodynamics of rotary wing aircraft and rotary wing control systems.

Ideally, academic training will also be provided new aviators concerning SAR mission planning and SAR equipment characteristics and capabilities. Other topics to be addressed within academic training concern management principles and techniques for effective control of the aircraft's resources for efficient mission accomplishment. Flight support lectures will be required explaining performance requirements.

Flight Training

Training objectives for the flying portions of each program of instruction designed for training Coast Guard aviators should be concerned principally with the completion of skill learning for those tasks practiced in the simulator. They must also be concerned with the accomplishment of that training which cannot be given effectively in a synthetic device. Chiefly these objectives are concerned with learning to control the aircraft on the basis of visual cues external to the aircraft. They include take-off and landing for all aircraft, water operations for the two helicopters and the HU16E, execution of drop procedures for fixed wing aircraft and helicopter hovering operations over moving targets.

Synthetic Training

Broadly viewed, aviation training within the Coast Guard has two principal functions: skill acquisition and skill integration. Skill acquisition refers to either the original learning of behavioral items not already within the student's repertoire or the modification/adaptation of existing skills in appropriate ways for application to new aircraft. This is the chief emphasis of transition and qualification training programs. Skill integration refers both to the progressive refinement of single skills (e.g., aircraft control) and also to the exercise of various skills in combination. While skill integration begins in transition and qualification training, it is the

chief benefit achieved through proficiency training. Both functions can be served by synthetic flight training equipment.

In developing aircraft-specific programs of instruction for use with synthetic equipment, specific training objectives should be concerned with (1) the development and enhancement of skilled performance for all instrument flying tasks (including transition to unfamiliar instruments) for the aircraft, (2) achievement of proficiency in the execution of all normal and emergency procedures for the aircraft, (3) development of skills required for effective communications, and (4) learning of complex patterns of psychomotor responses.

Future training programs should also use synthetic equipment to provide specific learning experiences for a wide variety of aircraft and environmental conditions. This "enriched" training will foster the early development of skills which normally otherwise develop slowly over time as experience in operational flying under diverse conditions increases. Intelligent, insightful use of the simulator can realize, for example, benefits such as

. allowing the student aviator to develop an appreciation for his own personal capabilities as an aviator and to develop a safe performance envelope within which he can operate effectively;

. permit the exercise and enhancement of decision making abilities;

. allowing the student aviator to develop the ability to control the aircraft consistently (reliably) and smoothly under diverse conditions;

. allowing the aviator to acquire effective procedures for time-sharing the performance of simultaneously occurring tasks.

LITERATURE CITED

SELECTED BIBLIOGRAPHY

AND

APPENDIX

LITERATURE CITED

1. United States Coast Guard, *Coast Guard Air Operations Manual*, CG 333, Department of Transportation, Washington, D. C., 6 January 1969.

2. United States Coast Guard, *National Search and Rescue Manual*, Department of Transportation, Washington, D. C.

3. United States Coast Guard, *Aircraft Emergency Procedures Over Water*, CG 306, Department of Transportation, Washington, D. C.

4. United States Coast Guard, *Flight Manual: Model HH-3F Helicopters*, T. O. 1H-3(H)F-1, Department of Transportation, Washington, D. C.

5. United States Coast Guard, *Flight Handbook and Standardization Manual for Model HH-52A Helicopters*, CG 384-1 (CGTO 1-H-52A-1), Department of Transportation, Washington, D. C.

6. United States Air Force, *Flight Manual: USAF Series C-130B Aircraft and USCG HC-130B Aircraft*, T. O. -1C-130B-1, Washington, D. C.

7. United States Navy, *NATOPS Flight Manual: Navy Models HU-16C, HU-16D Aircraft*, Department of the Navy, Washington, D. C., 1 March 1968.

8. United States Coast Guard, *HU-16E Standardization Manual*, CG 372, Department of Transportation, 15 July 1965.

9. United States Coast Guard, *Communication Manual*, CG 233, Department of Transportation, Washington, D. C.

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SELECTED BIBLIOGRAPHY

In addition to the documents cited, a variety of other documentation was reviewed during the study. In some cases specific portions of the documents were used in developing material for this report. Generally, however, the documents provided the background information necessary to the writing of the report.

U. S. COAST GUARD

1. *Radio Frequency Plan*, CG 233-1, 1963.

2. *Radiotelephone Handbook*, CG 233-2, 10 August 1967.

3. *HH-3F On-Site Transition Syllabus*, CGAS Mobile, 1968.

4. *HH-3F Operational First Pilot Training Manual*, CGAS Mobile, 14 November 1968.

5. *HU-16E Qualification Training Manual*, CGAS Mobile, 15 December 1966.

6. *HU-16E Transitional Training Manual*, CGAS Mobile, 15 December 1968.

7. *HH-52A Qualification Training Manual*, CGAS Mobile, 1 June 1967.

8. *HH-52A Operational Co-Pilot Training Manual*, CGAS Mobile, 20 October 1966.

9. *Re-Evaluation of the Requirements of Coast Guard Aviation*, Commandant, U. S. Coast Guard, Washington, D. C., 17 June 1960.

10. *Joint Report of the Secretary of the Treasury and the Commandant, USCG, on the Extension to the Reevaluation of the Requirements of Coast Guard Aviation*, Treasury Department and U. S. Coast Guard, Washington, D. C., 13 April 1966 and 7 March 1966.

11. *Interim Aviation Implementation Plan*, July 1968.

12. *Interim Aviation Implementation Plan*, Revision 1. 1 May 1969.

13. *Aviation Issue Paper, Volume I, Study*, September 1967.

14. *Aviation Issue Paper, Volume II, Data Bank*, September 1967.

15. *Aviation Issue Paper, Volume III, Geographical Distribution of SAR Incidents*, September 1967.

Commanding Office , U. S. Coast Guard Aviation Support and Training Center

16. *HH-3F Hover Rescue Procedures; Development and Evaluation of.* Memorandum to Commandant (OSR-2), Mobile, Alabama, 30 July 1969.

Miscellaneous Coast Guard

17. *SAR Standing Operating Procedures/Station Operations Instruction*
    - CGAS, Miami
    - CGAS, Elizabeth City
    - CGAS, Salem
    - CGAS, Detroit
    - CGAS, San Francisco
    - CGAS, San Diego

18. Summaries of hours expended for training purposes during Fiscal Year 1969 for 20 Air Stations.

19. Syllabi and other training materials from all Coast Guard Air Stations having a training mission.

National SAR School, Governors Island, New York

20. *Searchcraft Briefing Pamphlet*

21. *SAR Planning Data, Coast Guard Ships and Boats*

22. *Student Workbook*

U. S. NAVY

Chief of Naval Air Training

23. CNATRA INSTRUCTION 5452.2E, 15 August 1966. *Chief of Naval Air Basic Training; Mission and Tasks.*

24. CNATRA INSTRUCTION 5452.3D, 3 November 1966. *Chief of Naval Air Advanced Training; Mission and Tasks.*

Naval Air Basic Training Command, Chief of Naval Air Basic Training

25. CNABATRAINST 1542.31, 18 September 1967. *Syllabus, Flight and Flight Support; Senior Officers Orientation Course.*

26. CNABATRAINST 1542.54A, 11 February 1969. *Syllabus, Flight and Flight Support; Primary Phase, T-34B.*

27. CNABATRAINST 1542.55A, 20 December 1967. *Syllabus, Flight and Flight Support; Basic Training Phase (Prop), T-28.*

28. CNABATRAINST 1542.53, 27 June 1968. *Syllabus, Flight and Flight Support; Pre-Helicopter Phase T-28*

29. CNABATRAINST 1542.30B, 25 January 1967. *Syllabus, Flight and Flight Support; Helicopter Training.*

30. CNABATRAINST 1542.63F, 6 January 1969. *Basic Academic Training Syllabus.*

31. CNABATRAINST 1542.65E, 21 November 1968. *Training Syllabus, Naval School, Flight Systems, Naval Aviation Schools Command, Pensacola, Florida.*

<u>Naval Air Advanced Training Command, Chief of Naval Air Advanced Training</u>

32. CNAVANTRAINST 1542.2A, 23 March 1967. *Syllabus, Flight, Naval Aviator and Naval Flight Officer Navigation Training.*

33. CNAVANTRAINST 1542.5, 10 October 1966. *Syllabus, Flight, Flight Support, and Academic, Prospective Prop Flight Instructor.*

34. CNAVANTRAINST 1542.4, 10 October 1966. *Syllabus, Flight, Advanced Prop Pilot Training.*

35. CNAVANTRAINST 1542.1A, 4 March 1968. *Master Academic Training Syllabus, Promulgation of.*

U. S. AIR FORCE

36. 4442D Combat Crew Training Wing. *Training Materials Used in C-130 Training Program.* Sewart Air Force Base, Tennessee.

Appendix

U. S. COAST GUARD AIR STATIONS VISITED IN THIS STUDY

Visits were made to the installations listed below on the dates indicated to obtain information concerning Coast Guard aviator practices during operational search and rescue (SAR) missions.

1.	10 - 13 March 1969 28 - 29 July 1969	Training Section U. S. Coast Guard Aviation Support and Training Center Mobile, Alabama
2.	14 March 1969	Coast Guard Air Station New Orleans, Louisiana
3.	8 - 10 April 1969	Coast Guard Air Station Miami, Florida
4.	14 - 16 April 1969	Coast Guard Air Station Elizabeth City, N. C.
5.	17 - 18 April 1969	National Search and Rescue School Governors Island, N. Y.
6.	21 - 23 April 1969	Coast Guard Air Station Salem, Mass.
7.	8 - 9 May 1969	U. S. Naval Air Training Command Pensacola, Florida
8.	12 - 13 May 1969	Coast Guard Air Station Detroit, Michigan
9.	23 - 24 June 1969	Coast Guard Air Station San Diego, Calif.
10.	25 - 27 June 1969	Coast Guard Air Station San Francisco, Calif.

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13. ABSTRACT

An analytical study was conducted to define desired functional characteristics of modern, synthetic flight training equipment for the purpose of producing potentially better qualified aviators through a combination of aircraft and simulator training. Relevant training which aviators receive in preparation for specific aircraft duties and training requirements for Coast Guard aviation are discussed. To meet these objectives, a comprehensive study of aviator requirements during operational missions was undertaken. The search and rescue (SAR) mission was chosen for the analysis, and missions were chosen to represent operations in each of the four aircraft used by the Coast Guard primarily for the SAR. The interview data were used as the basis for developing a narrative description of aviator performance in the accomplishment of SAR missions and to compile a tabular listing of the specific tasks involved. The study reveals desirable functional characteristics for synthetic devices and provides a basis for subsequent development of specific operationally oriented training programs.

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